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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than Monday noon to assure publication in that week's issue.

UTILIZING THE POWER OF TIDES AND OTHER FORCES.

Utilizing the power of tides is an inviting proposition, but even under those conditions where there is a rise and fall of twenty or thirty feet, it has been shown that a tide motor would not be a paying investment. There are four sources of power at present in use, the various kinds of fuel, waterfalls, wind and the sun. The first two form our main dependence. Windmills are useful for small powers where other means are inconvenient, and in certain sections of the country, where cloudless days are the rule, the heat of the sun has been used on a small scale to drive machinery. At present there seems to be no reason to believe that the important position now occupied by fuel and waterfalls will be approached by any other source of power.

NATIONAL ELECTRIC LIGHT ASSOCIATION CONVENTION.

The convention of the National Electric Light Association at Chicago last week has left a permanent record of great value. For some months past it has been held by many that the high water-mark of convention success was reached last year at Cincinnati. A new position, and one in advance of all previous ones, has, however, been attained by the association in the Chicago convention, and greater force and dignity will henceforward be accorded the serious documents and affairs which the association shall father.

Large and Earnest Meetings.

President Ferguson has faced exceptionally large and interested audiences on each of the convention days and at all times has been sustained by a responsive temper in his audiences, which it is not often the good fortune of a chairman to feel. On several occasions the convention hall was packed to the limit, when favorite topics were under discussion. The value of the matter brought out in some of the discussions will be far-reaching in its effect, and the general prosperity of the lighting and power interests will doubtless be materially benefited by the ideas which many have taken home with them.

Improved Office Methods Urged.

The contribution by Mr. W. M. Anthony is one of the most important made in recent years. It contains many suggestions of great value, especially to those plants that have in a measure been lax in the administrative and accounting methods employed. His paper brings out strongly the value of the association in placing in the hands of the officers and managers of the smaller plants the results of the experience of the servants of a great corporation, one equipped with a staff possessing great technical skill in all departments, and which thereby presents as good a model for the emulation of a developing property as need be wished for.

Interest in the Steam Turbine.

The steam turbine came in for a generous share of attention, owing to the attractive presentation given it by Professor Robb, and the general interest in it, which is now ripe in engineering quarters. That the steam turbine has a remarkable future before it no one doubts; that it promises to be a winning competitor of its fast developing associate the gas engine, and that it may even discount the economic record of late hydraulic power installations, are matters of such great import that one must needs stop and think.

All Phases of Electrical Supply Received Attention.

At this convention lighting as well as power has occupied a prominent position —arc, incandescent, Nernst and gas lighting have all received a full measure of attention and comparison. The central station managers are certainly, as the result of this convention, equipped with much better information than ever before as to the relative merits and economies of the several prominent illuminants, and much of the uncertainty that has hampered and entangled the mind of him who would decide between them is removed. The thanks of the electrical fraternity are again due to Professor Matthews for an excellent report.

The Presidential Address.

Our editorial space does not admit of calling attention to each and every element that has made up the sum of success of the Chicago convention, and on the score of which we congratulate President Ferguson. We must, however, call pointed attention to the excellence of the points made in the presidential address, which all should read, as well as to the fact that the president and the reception

committee have established Chicago's reputation for hospitality on a firmer foundation than ever.

Meetings Next Year.

The announcement that the next general convention of the association will be held in Boston, and that the association will also hold a special meeting during the Electrical Congress Week, at the Universal Exposition of 1904, St. Louis, we are certain will be received with much satisfaction by the membership. To be the guests of President-elect Charles L. Edgar in historic Boston the West will come right loyally, while with no less satisfaction will the East join the West in meeting representatives of the electrical fraternity of foreign lands in congress assembled at St. Louis.

We congratulate President Edgar and the association on the promise of the future.

ELECTRIC FURNACES.

Much has been written concerning the wonders accomplished by the electric furnace in various lines of work, but except in a few special applications we do not seem to have progressed very far in its application. In this issue of the ELECTRICAL REVIEW Mr. J. B. C. Kershaw discusses the various attempts to apply the electric furnace to the production of iron and steel, and reaches some interesting conclusions as to the commercial applicability of the various processes.

Classes of Furnaces.

Electric furnaces are usually divided into two classes, known as the arc and the incandescent, according to the method of converting the electrical energy into heat. Each of these types might be further subdivided, according to the character of the supply, into direct-current and alternating-current furnaces. Where the effect of the current is merely to produce a high temperature, it is usual to find the alternating type employed, because of the greater ease with which this character of current is handled and controlled. On the other hand, where electrolytic action is necessary to produce the desired result, recourse must be had to the direct-current type. The most notable instance of the use of the direct-current furnace is in the production of aluminum, where electrolytic decomposition is brought about, and the use of the current to produce a high temperature is merely incidental. Where the electrical current is used merely as a convenient method of heating, the heat is developed by forcing the current through a resistance. The resistance may be in the form of an arc or a core of graphite placed in the furnace, or even the material to be acted upon itself.

Not Always Economical to Heat Electrically.

Where electrolytic action is necessary there is, of course, no choice and energy in the form of electric current must be used. Furthermore, by the use of the electric current we are able to attain temperatures higher than those reached by other methods; but if only moderately high temperatures are required, such as are produced in the blast furnace, in general it will not be found economical to produce this heat electrically. Where a steam generating plant is installed we in general lose some ninety per cent of the heat of the coal in order to convert less than ten per cent of it into a convenient form for handling; and where water power is depended upon, generally the cost of development is such as to make this method of production of heat an expensive one. Since the conversion of electricity into heat is an expensive method of heating in those cases where the high temperature of the electric furnace is required, it would seem that a great saving might be effected by a previous heating of the raw material in some form of blast furnace, before introducing it into the electrical furnace.

Electric Smelting Is Expensive.

In summing up his discussion, Mr. Kershaw shows that in all electric iron-smelting processes the actual reduction of the ore is effected by the carbon, and not electrolytically. In other words, the electrical energy was used merely as a heating agent. The amount of energy required per ton of iron seems to vary considerably in different processes. Four out of the seven give figures considerably over 3,000 electrical horse-power-hours. The saving in coke from the use of electricity is only 950 pounds, so that with the prevailing prices for coke and electrical energy it is difficult to see how these methods can be successfully operated, except where coal is very expensive and water power cheap.

New Methods May Give Better Results.

It should be remembered that the electrical methods usually require a preliminary treatment of the ore, which, of course, adds to the expense. In two of the processes described above the energy required is considerably less than 3,000 horse-power-hours, so that here it would seem distinct progress has been made. This is doubtless due to a radical departure from the old blast furnace method, which, although admirably adapted to reduction by means of carbon, seems not to be suitable for the electric method. It is possible that even better results may be obtained by striking out in new lines, but as long as electrical energy is used merely as a heating agent, it has long odds to overcome. In the opinion of Mr. Kershaw, the development of electric furnace methods of iron ore reduction will be slow, and the use of water power on an extended scale in this industry will be postponed to some time in the future when the coal fields of North America and Europe are approaching exhaustion.

AUTOMATIC BLOCK SIGNALING.

Recently on one of our railroads the operator at a block signal station was found dead at the levers, but fortunately no accident was caused by this failure of the manual system. It is better, however, to take warning from such failures where no accident is caused, rather than wait for the more impressive lesson of a serious wreck.

Manual Signaling Should Be Supplemented by an Automatic System.

It is most probable that the death of an operator would merely block the road until trouble was found, but it might occur at a time when the signals showed a clear track, and result disastrously. However, with an automatic system supplemented by a manual system, it is highly improbable that both would be thrown out of service at the same time.

Additional Expense Not a Serious Drawback.

The argument against maintaining duplicate signaling systems, based on the ground of expense, can not be made very strong, because it is not unusual in engineering works, where the consequence of a complete shutdown would be serious, to maintain two independent systems. Power stations are always provided with reserve units, and important electrical transmission lines are very generally installed in duplicate.

Electric Furnace Methods of Iron and Steel Production.

By John B. C. Kershaw.

MUCH attention is now being devoted to the problem of steel production in the electric furnace, and a large number of engineers and electrometallurgists are devoting time and money to this new and interesting application of the electric current as a heating agent.

The aim of these investigators is to design a furnace and process which will permit of the reduction of the ore and of the direct production of steel, or of any desired alloy of iron with nickel, chromium, manganese, etc.—in one or at most two operations, without any use of carbon, beyond that required for the actual combination with the oxygen of the ferric-oxide present in the ore. Electricity is, therefore, to take the place of all coke or carbon used for heating purposes in the ordinary blast furnace process. The solution of this problem is no easy task, for the electric furnace is not an economical heating appliance when large masses of material have to be dealt with; and the ordinary blast furnace with which it is to compete is the most economical and efficient appliance for the utilization of the energy of fuel that man has ever invented. Owing to the large mass of material to be heated, the most efficient method of applying the electric current, namely, arc-heating, is beset with special difficulties. Should this method of heating be applied, a preliminary grinding and mixing of the ore with the coke and flux will be necessary—for only small portions of this mixture can be brought under the action of the arc at any one moment of time. This preliminary treatment will be expensive, and is likely to add a very large percentage to the actual cost of the whole process of smelting in the electric furnace. Electric resistance furnaces, designed on the blast furnace principle, into which the ore lime and coke are charged in the lump condition, and in which the necessary mixture of the raw materials is effected by gravitation as the half-molten charge slips toward the throat of the furnace, would consequently appear to offer the greatest advantages, since the costly grinding and mixing of the charges could in this case be dispensed with.

Both types of furnaces—namely, the arc and the resistance furnace—have been experimented with and trials upon an industrial scale of several of these furnaces are now being carried out. Details of all the electric furnaces designed for the production of iron and steel, that have received actual trial, are given below, and where possible these descriptions are accompanied by sectional diagrams or by diagrammatic views.

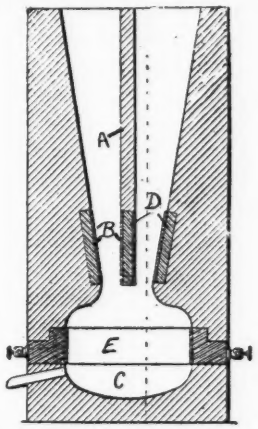


FIG. 1.—THE CONLEY FURNACE.

The Conley Furnace and Process.

Fig. 1 shows a diagrammatic sectional elevation of the Conley furnace.

The furnace follows the blast furnace principle in construction; but a central partition wall A is added, and iron plates BD fixed in the throat of the furnace convey the electric current to the charge, and cause the production of heat on the resistance principle. The partially fused mass then falls on to the hearth C of the furnace, which is heated by a belt-shaped ring of plates E, and the reduction of the ore is completed in this portion of the furnace.

It has been stated that a Conley furnace to produce 100 tons of steel ingots per day would require 5,000 electrical horse-power, and that the ingots could be produced in such a plant at a cost of $11.80 per ton.

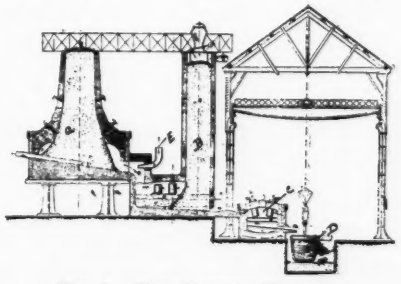


FIG. 2.—THE HARMET FURNACE.

The writer is not aware what reliability can be attached to this estimate, but the fact that companies have been formed to exploit and work the Conley patents proves that there are some people who have faith in the furnace and process. The Conley patents are being exploited by the Electric Furnace Company, of New York, capital $200,000, and a subcompany has been formed to finance and erect an 8,000-horse-power plant at Elizabethton, Tenn. The Massena Electric Steel Company, with a capital of $500,000, has also been promoted, to erect and work a similar plant at the new water power centre at Massena, N. Y. The writer's opinion of the financial prospects of these, and similar projects elsewhere, will be found in the final section of this article.

The Harmet Furnace and Process.

Fig. 2 is a sectional elevation of a plant constructed on the Harmet principle. The ore is charged into the inverted cone-shaped furnace *a*, and passes from the inclined hearth of this on to the hearth of B, where it meets the coke necessary for its reduction. The molten iron or steel flows from the hearth of B into the refining furnace C, and after the requisite heating is tapped into the ladle D. The hot gases from B are drawn into *a* by air injection at E, and these assist in the preliminary heating of the ore. Each separate division of the plant is heated by electric current from suitably arranged carbon electrodes, resistance heating being employed in *a* and B, and either resistance or arc heating in C.

This original Harmet furnace resembles in many points that of Heroult. In each case the ore and lime are subjected to a preliminary heating, in which the waste gases from the reducing portion of the furnace assist, before being allowed to come into contact with the coke, the supply of which is kept up by the pressure of a vertical column of the same.

In a later publication Harmet describes a plant which is more compact in form, and in which the ore mixture and coke, after preliminary heating, are fed together into a vertical reducing tower. The Harmet furnace is reported to be in successful operation at St. Etienne, in France, and, according to the inventor, one ton of steel can be produced in it with the expenditure of 3,600 electrical horse-power-hours. The estimated cost of one ton of steel by the Harmet process is only $5.60.

The Heroult Furnace and Process.

The Heroult furnace is shown in sectional elevation in Fig. 3. The principle

of this furnace consists in the continuous supply of the half-fused ore and mixing materials to a column of coke, kept at a red heat by means of the electric current. The Heroult furnace is therefore of the resistance type.

In Fig. 3, A is the outlet of the preliminary heating furnace, H is the vertical shaft which is filled with coke, and Z is the hot zone of the furnace, in which the reduction actually occurs. G, F and B are carbon blocks and function as electrodes, the current terminals being placed at I and J. The current passing from B to F and from B to G, through the coke, maintains this at a red heat, and as the pasty mass of ore and lime is pushed over the edge of F, it is likewise heated by the current passing between F and G, and is rendered more fluid.

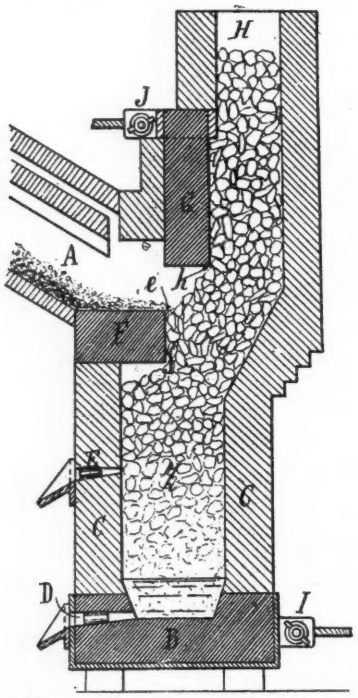


FIG. 3.—THE HEROULT FURNACE.

The charge in its descent through the hot zone Z spreads out, and during its contact with the red-hot coke reduction occurs. The supply of coke is kept up by feeding the column in H. The gaseous products of the reduction pass away by *e* and A, and thus assist in the preliminary heating of the ore. The Heroult furnace has been tried on an experimental scale by the Societe Electrometallurgique Française at La Praz, in France, but the writer has not seen any figures for its cost of operation, and he is not aware that any large scale trials has yet been made with it.

The Keller Furnace and Process.

A plant for operation of the Keller process is shown in sectional elevation in Fig. 4. It consists of a reducing furnace A, constructed on the blast furnace principle, in which resistance heating is employed, and of a refining furnace B, in which either resistance or arc heating can be used. The slag from the reducing furnace flows away at C, and the metal at D. An experimental plant on the Keller principle has been erected at Kerrousse, Morbihan, in France, where 550 horse-power are available for the manufacture. According to a pamphlet published by the firm of Keller, Leleux & Cie, of Paris, which is exploiting the Keller patents for iron and steel production, one metric ton of steel can be produced by the Keller process with an expenditure of 2,800 kilowatt-hours and the cost is estimated at between $17.50 and $19.20. The first furnace erected at Kerrousse required 375 horse-power to work it, but a larger furnace to produce fifteen to twenty tons of steel at one charging has since been erected. The raw material used at Kerrousse is reported to be New Zealand iron sand from Taranaki.

The Kjellin & Benedicks Furnace and Process.

This process is in operation at the Gysinge foundry, in Sweden, where 300

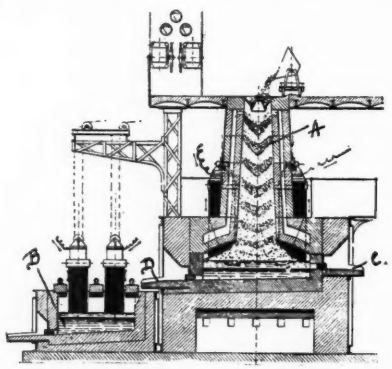


FIG. 4.—THE KELLER FURNACE.

horse-power utilized up to August, 1901, in a wood-pulp factory, is now available for the reduction of iron ores. The process differs from all hitherto described, in the use of induced currents for heating the mass of ore and coke. Fig. 5 shows the arrangement of the Benedicks furnace. The metal or ore contained in the annular space B forms the conductor, and heat is produced in this by rapid changes in the magnetic condition of the central core *d* and the coil *a* surrounding it.

The principle of the method is, therefore, similar to that which has been used for welding by aid of electricity, but it is not evident that it can be applied with advantage to the heating of large masses of ore, coke and lime. However, the furnace is reported to have been successfully operated at Gysinge, in Sweden, in February, 1900, and 270 kilogrammes and 650 kilogrammes of steel were said to have been produced in it per twenty-four hours, in two trial runs. A larger furnace has since been erected at this place, and in a United States consular report, dated 1902, an estimated annual produc-

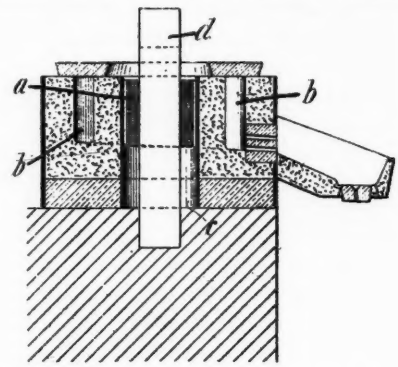


FIG. 5.—SECTIONAL ELEVATION OF THE BENEDICKS FURNACE.

tion of 1,500 tons of steel by the Benedicks process is referred to. The Spanish Government is also reported to be making trials with this furnace and process at Villa-Rubia, on the Tagus, in the province of Toledo. The only figures upon which the electrical efficiency of the process can be based are contained in the 1900 United States consular report, already referred to. These show that seventy-eight kilowatts were required to produce 650 kilogrammes of steel in twenty-four hours. This equals 3,910 electrical horse-power-hours per ton of steel.

(To be continued.)

Costs of the London County Council Tramways.

The financial statement for the city of London for the past fiscal year gives some interesting figures relating to the cost of the city's tramway system. It had been estimated that the surplus from the tramways would be £42,000, while it only amounted to £20,000. The report states that this fall was due almost entirely to the dislocation of traffic during the reconstruction of the lines on the south side of the river for the purpose of electric traction. The tramway lines between Tooting and the Westminster, Black Friar's and Waterloo bridges were opened on May 15. These have just been converted to the electrical conduit system. The cost of the Tooting line is given in the report of the Highways Committee as follows:

	Total.	Rate per Mile.
Rails and road work.....	£224,020	£13,660
Cars—6.1 to the mile.....	72,500	4,420
Power station and cables...	74,000	4,510
Substations.....	20,600	1,255
Cars, sheds and workshops.	34,000	2,075
Incidentals.....	15,000	915
	£440,120	£26,835

THE DESIGNING OF TELEPHONE APPARATUS—XXIII.

BY W. A. TAYLOR.

A modification of the Stone circuit is used by most of the independent telephone companies in this country. These circuits differ from the Stone system, because they are not affected by the trouble due to lines of unequal length. Fig. 62 shows the diagram of such a circuit. A, B, C and D are four impedance coils, E and F are condensers. The current for the telephone G is supplied by battery K through the coils B and D. The current for the telephone H is supplied through coils A and C. Without the condensers F and E there could be no transmission between telephones H and G. The action of this system is as follows: The transmitter H varying in resistance by increasing or decreasing causes a change in potential between the points 1 and 2. Without the condensers there would be no variation in the potential between points 3 and 4, but with the condensers in circuit, as shown, any rise or fall in the voltage on one side of the circuit would cause a charge to enter the condensers and therefore a change in the potential of the line on the other side as current rushes from the line to charge the other side of the condensers. In this manner the transmission of the voice is accomplished and at the same time each line circuit is supplied with a current that is unaffected by the other line. These impedance coils are sometimes merely coils serving no other purpose, but generally they are made to serve the purpose of relays. The number of combinations of circuits are exceedingly numerous, some of them very good and others indifferently so. One great weakness which is shown in many central energy circuits lies in the supply of battery. Either through a desire for economy in power or because of fear from cross-talk a number of designers have made the coils through which the battery is supplied of so great a resistance that not sufficient current is given to the line. While the circuits permit talking of a certain loudness, the transmission is not as good as is possible with a well designed circuit.

One of the first questions to be settled in a circuit like that shown in Fig. 62 is how low a resistance or impedance can safely be used in the coils without a serious loss from short-circuiting through the battery, and this will determine the quantity of current which can be sent over the line with a battery of a given voltage. The only way to find out this point is to try coils of different impedance against each other, commencing with the higher values and reducing them gradually. The transmission will be found to gradually improve with the increase of current (the resistance is also reduced) until a point is reached where the transmission falls off because of the short-circuit effect; at this change point will be the point of maximum efficiency for transmission. In a system with twenty-four volts it was found that if each of the impedance coils were wound to forty-five ohms over a Norway iron core three-eighths of an inch in diameter and three inches long and 2,000 turns, a maximum efficiency was reached. Such a system would supply 0.266 ampere to a line of no resistance, or if a telephone of seventy-five ohms were inserted a current of 0.145 ampere would flow. A mile of No. 19 B. & S. copper wire in the cable will reduce this current to 0.096 ampere and the voice will still be heard loud and strong. In truth, to the average user, there will not be much difference noted in the current with the amount reduced to 0.05 ampere, if all the apparatus in the circuit is well designed. In reality, there would be considerable reduction and it would be very noticeable on comparison with another circuit having the full amount of current. Compare such a circuit described above with a circuit where it is impossible to get more than 0.06 ampere on the shortest line. With any length of line there would be very poor service. One system which was introduced a few years ago permitted but 0.06 ampere to flow on a short-circuit. The transmitters on the line were of the local battery type, requiring over one-half of an ampere on local battery service. They were unable, therefore, to get more than one-tenth the quantity of current required for good service. All this trouble arose because of the indisposition of the engineer to study his subject and carefully work out the details before introducing the system.

The voltage of the battery should largely be determined by the quality of the line construction and the length of the lines. Probably the highest voltage used in exchange work is forty and the lowest about twenty. The voltage should be sufficient to work all the signals positively over the longest line. If the lines are well built and no extra long lines, twenty volts will work all of the relays nicely on most circuits, though on some kinds of combinations a greater voltage is necessary, because in ringing the ringing current would be short-circuited through the electromagnetic apparatus of the circuits, unless it is wound quite high. The high-wound apparatus necessitates a greater voltage in order that sufficient current may be given to the line. It is well to hold the voltage as low as twenty-four, as with the higher pressures it is quite difficult to keep the transmitters from frying. With this low voltage sufficient current can ordinarily be sent out over the line and there is less danger from a burnout due to the high voltage. Unfortunately many of the exchanges have their lines in such poor condition that it is absolutely necessary to raise the voltage of the system. Cases are in existence where the battery had to be doubled and all the apparatus wound higher to accommodate lines in an exchange that were in bad shape.

All the windings of the various electromagnetic apparatus in the circuit must be of sufficient capacity to carry the full amount of current indefinitely without heating unduly.

The condensers in the cord circuit, as shown in Fig. 62, should be not less than two microfarads' capacity; with a less capacity the transmission lacks volume and carrying capacity.

It must be admitted that there is considerable excuse for increasing the voltage on the lines, as is shown by the following table. The quantity of current flowing on a line of no resistance is taken as constant, so that the impedance coils are wound to a higher resistance. The amount of current flowing on such a line is 0.15 ampere.

Voltage.	Current on Shortest Line.	Resistance of Coils and Telephone.	Resistance of Line Carrying 0.05 Ampere.
20	.15	133	267
24	.15	160	320
30	.15	200	400
35	.15	233	467
40	.15	266	534

It is seen from the above that with forty volts it is possible to transmit current over a line resistance of 534 ohms before the amount reduces to 0.05 ampere, while with twenty-four volts the line resistance for the same quantity of current would be 320 ohms. With the forty volts taking cable composed of No. 19 copper wire as a basis, the line may be 6.3 miles long, while with twenty-four volts the line would be 3.76 miles long. It will be found that there are very few cases where an exchange line will be longer than three miles and therefore there will be no real necessity for the heavy voltage.

There is also another reason for not increasing the voltage. The increased voltage makes it necessary to add resistance to the switchboard circuits. Because of this increased resistance in the switch-

board and the increased voltage, any given change in the resistance of a transmitter will not produce as great a change in the current flowing and consequently the transmission will suffer correspondingly. Taking a variation of fifty ohms in the transmitter as a basis to figure from and a line of 100 ohms resistance, a current of 0.0858 ampere would flow normally, the voltage being twenty, and the resistance the same as shown in the table. An increase of fifty ohms would make the flow 0.0706 ampere, a change of 0.0152 ampere. With forty volts, the same line resistance and the same change in resistance of transmitter there would be a normal flow of 0.1092. With the added fifty ohms in the transmitter there would be a current of 0.0961 or a change of 0.0131 or less than that of the circuit of twenty ohms by 0.0022 ampere. Suppose that the resistance in circuit with the forty-volt battery were the same as that of the twenty-volt circuit, then the normal flow of current would be 0.171 ampere and the current flowing after an increase of fifty ohms would be 0.141, a difference of 0.03 ampere. This shows a proportional increase so if it is desirable to secure an increase in the transmission it is best to increase the voltage of the battery without increasing the resistance of the impedance coils. It is seen from the above figures that it is not for the good of the service to have abnormally high resistances in the switchboard circuits. Besides being a great detriment to talking, it makes an additional cost in the apparatus and in the battery. Where coils are of such high resistance the wire must necessarily be fine. With fine wire coils, breakdowns from lightning and other extraneous causes are more apt to happen, for it is much more difficult to make effective protectors without introducing undue resistance to the line.

Something of the size of the storage batteries necessary for the running of a system may be determined only by knowing the circuit to be used and the number of calls. The promptness of the operators in disconnecting and answering calls is a considerable item. The reliability and source of the charging current must also be taken into consideration. In a system where a very reliable single source of energy may be obtained or, what is still better, where two separate and distinct sources are available, it is not necessary to provide batteries of greater capacity than just enough to stand twenty-four hours. Where the lines for power are apt to get out of order during extended times, as is more or less common, or where there is but a single set of battery charging machines, it sometimes becomes necessary to provide a battery which will carry the exchange for a week without recharging.

It is much better to provide two sets of batteries and two sets each of charging and ringing machines with throw-over switches, so that any machine may be instantly changed.

The power end of the exchange must be especially well cared for, as any accident there is apt to put the whole system out of use. All the wiring and all the equipment must be as nearly perfect as can be obtained.

A common way to choose the size of battery is as follows: Figure each call as three minutes in duration; three seconds which the operator requires for answering and three seconds for a disconnection after the supervisory lamps light. The pilot lamps on each position will be in

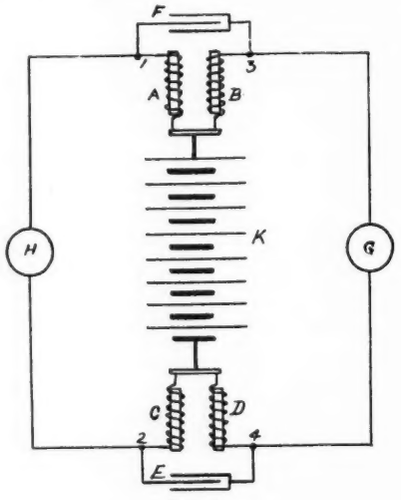


FIG. 62.

operation about one-fourth of the time. The operator's transmitters will all be connected in circuit about fourteen hours of the day, and that is all the time it is necessary to figure on; the rest of the day the system is practically idle. If we figure on an exchange of fifteen hundred subscribers it will be found that each subscriber will average not to exceed fifteen calls a day. In most exchanges the number of calls is less than this. The following will then be the items as figured when a twenty-four-volt battery is used.

	Ampere Hours.
22,500 calls, 3 seconds' wait in line relay current averages 0.08 ampere	1.50
22,500 calls, 3 seconds' wait in line lamp current averages 0.06 ampere	1.12
22,500 connections, 3 minutes—cutoff relay current averages 0.05 ampere	56.25
22,500 connections 3 minutes—talking current 0.1 ampere for each line, averages 0.2	225.00
22,500 connections, 3 seconds—supervisory lamp current 0.12 ampere	2.25
15 line pilot lamps 0.06 ampere each, 14 hours.	12.60
15 supervisory pilot lamps 0.06 ampere each, 14 hours	12.60
15 operators' transmitters 0.12 ampere each, 14 hours	25.20
Total	336.52

The battery for this system must therefore be able to take care of a discharge of 336 ampere-hours during a period extending over fourteen hours of the day.

The battery must therefore be the nearest size above this; this size will probably be 350 ampere-hours. This rating is for the normal discharge of one-eighth of the capacity each hour. It is probable that the discharge may be greater than normal at different periods of the day, but if the battery is well made it will stand discharging at a three-hour rate. The above-sized battery is for a maximum busy day; the chances are that the average day will not discharge the battery more than two-thirds, but the battery must be of sufficient size to take care of the heaviest drain. If there is a relief battery there will then be sufficient battery capacity for two days. Where the battery must at times be expected to last longer the size must be increased accordingly. All systems do not have cutoff relays and neither do all have as great a flow of current for talking as the above. In such systems the batteries may be much smaller. The writer has in mind one exchange of twelve hundred subscribers in which the maximum discharge during any day is not more than twelve amperes and the average not more than six amperes. Of course it is possible for such an exchange to give some sort of service, but it must positively be remembered that if first-class service is to be rendered, a sufficient amount of current must be provided to the apparatus to make it work positively.

Annual Meeting of the Pacific Coast Electric Transmission Association.

The next annual meeting of the Pacific Coast Electric Transmission Association will be held on June 16 and 17, 1903, probably at the Hotel Rafael, in San Rafael, Cal. A number of interesting topics are proposed for discussion, and the convention promises to be the most successful of any thus far held.

Directory of the Scientific Alliance, of New York.

The eleventh and twelfth annual directory of the Scientific Alliance, of New York, has been issued. This gives a list of the several scientific associations forming this alliance, a list of the officers, and reports of the secretary and treasurer. An alphabetical list of the authors of papers presented before the societies from October, 1900, to June, 1902, is included, and also a directory of members.

Electric Haulage on Canals.

By Frank C. Perkins.

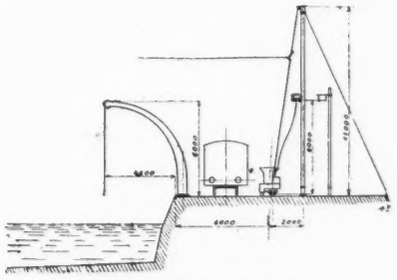
SINCE the prize competition of electric canal haulage systems in connection with the Teltow Canal, considerable attention has been called to what has been done in this line during the past decade. The Teltow Canal, nearly forty miles in length, it is said would carry nearly 5,000,000 tons per annum, connecting the rivers Spree and Havel. The committee in charge of the competition offered prizes of about $3,000 for the best system of canal haulage using electric power, and a score of applicants took part in the competition.

It may be of interest to consider some of the work done in electric canal haulage before going into details in reference to these tests. In Germany, France, America and other countries experiments have been made with electric canal haulage systems with varying success during the past ten years or more. Recently it has been seriously questioned whether the railroads would be able to supersede the canals entirely or even compete successfully against them, when electrically equipped, for moderate speed transportation of freight. The general tendency is to enlarge canals for accommodating larger boats, the early ones of 100 tons and 200 tons being considered far too small. The Erie Canal has been somewhat enlarged and will undoubtedly soon be reconstructed and electrically equipped for handling immense quantities of freight. The Oder-Spree Canal was enlarged for boats of 450 tons and the same tendency was shown in connection with the Dortmund-Ems Canal for boats of 750 tons and the great Mitteland Canal.

The accompanying illustrations and diagrams show the electric canal systems using two rails and one rail upon the towpath or at one side of it. Lamb's aerial system has been tested in America on the Erie Canal, near Buffalo, some years ago and on a canal near Eberswald. A strong steel cable is used in this system for supporting the motor carriage, which receives its current from an overhead trolley wire and travels along the suspended cable. The steel cables are all supported on posts along the bank of the canal, the propelling mechanism consisting of a revolving drum which winds itself on and along a second steel cable provided for the purpose. The length of the system installed for this test was somewhat less than half a mile.

The motor used on the Finow Canal trial was of about one-ton weight, of 500 volts pressure, and of five-horse-power capacity, while the speed attained was about 13,000 feet per hour or 3.6 feet per second. The suspended system of haulage is open to the objection on canals of many curves and turns that many supporting posts are required. The weight of the heavy cable required is said to be an objection, while many engineers claim the cost of maintenance would be high. One of the advantages claimed for this system is that it leaves the bank free for other traffic.

The Koettgen electric canal haulage system employs one rail in some cases and two rails in others, where tests have been made as on the Finow Canal. The electrical equipment was supplied by Siemens & Halske, of Berlin. The length of track used was about 3,300 feet and the



ELECTRIC TOWING ON CANALS.

electric locomotive is employed for hauling the canal boats. The single rail is placed farthest from the canal, so as to impede other traffic on the canal as little as possible. Two of the locomotive wheels are grooved and small in diameter, carrying more than three-fourths of the weight. These small grooved wheels rest upon the rail, while a pair of broad tire wheels, spring suspended, are employed on the side toward the canal, rolling along the towpath on the ground.

This single-rail locomotive has a fifteen-horse-power electric motor operated at 500 volts pressure, the direct current being supplied from an overhead trolley. This hauling locomotive is said to have made a speed of five and one-half miles per hour, the normal speed being about three miles per hour. The motor weighs about 4,000 pounds and the locomotive is low, an upright carrying the trolley pole, as shown in the accompanying illustration.

Where two rails were used on the Finow Canal test with the Koettgen electric locomotive haulage system, a one-metre gauge was employed and the two rails were supported on cement blocks in place of the usual ties employed in track construction. During these tests the locomotive was able to haul three loaded barges with a 700,000-pound load at a speed of three miles per hour, also two loaded and two empty barges at the same rate of speed. It has been estimated that with a traffic of 10,000,000 tons per year the cost with this electric system would be 0.0029 cent per ton-mile, and with 3,000,000 tons per year, 0.0038 cent per ton-mile, while with steam power under like conditions the cost would be 0.0042 cent and 0.0058 cent, respectively.

The English aerial electrical canal haulage system devised by Thwaite & Cawley provided a method which would not interefere with the use of horses and was designed to prevent the waste of energy incurred with a screw propeller. The aerial railway provided in this system consists of two steel rails of channel section braced together at one side to form a rigid girder. These were supported about ten feet above the towpath by cast-iron brackets or by wooden posts placed about thirty feet apart. Each of these rails was used for supporting electric locomotives of small size, having four wheels. Two of the wheels were operated on the upper surface and two pressed upward against the lower surface, the motive power being supplied by an electric motor geared to the four axles by worm-gearing, running in oil. A direct-current series-wound motor was used, the tractive force required for towing a barge of 100 tons at two and one-half miles per hour being estimated at 250 to 300 pounds. The small locomotive was controlled from the barge, no operator being required except on the boat. The current required was said to be fifteen amperes at 500 volts when starting up to a speed of four miles per hour. Mr. A. H. Allen, in reference to this system, gives the following as the cost per ton-mile and time occupied in transit with horses and electric power: With horses at two and one-half miles per hour and fifteen hours as time occupied in transit, 0.077 penny; with electric haulage at same rate of speed and twelve hours, 0.032 penny; while with electric haulage at four miles per hour and time occupied during transit seven and one-half hours, the cost of same per ton-mile is given as 0.041 penny. The ad-

vantages given for the electric haulage system are that the delays in passing are avoided, bridges and tunnels give no difficulty, power can be supplied to private consumers, cost of haulage is reduced and time of transit as well.

The Galliot system employed on the Burgundy Canal employs an electric tricycle which is operated along the towpath. A six-kilowatt motor is utilized, which receives the current from a suspended trolley wire, a towrope being used for hauling the barges. The tricycle locomotive weighs 4,000 pounds and tows a number of boats with 700 tons at a speed of one and one-quarter miles per hour. The power required is stated as follows by Van der Wallen: With a load of 387 tons at the above speed the power utilized is 3.45 kilowatts; with 186 tons and a speed of 1.37 miles per hour, 1.8 kilowatts, and with the tricycle alone at a speed of 3.75 miles per hour 0.9 kilowatt.

Electric Canal Towing Locomotive.

The Bouguie system of chain haulage has also been tried upon a portion of the Burgundy Canal. A motor is placed upon the barge which drives a chain haulage gear and the current is supplied by means of two trolleys and two trolley wires. With this system the cost is said to be 0.67 penny per ton as compared to 0.98 penny per ton for steam haulage, the distance being somewhat less than four miles, half of which are in tunnel.

On the Charleroi Canal to Brussels, which is fifty miles in length, the Gerard system is employed. At Oisquercq, sixteen and one-half miles from Brussels, the power-house is located, which supplies the necessary current. The total engine and boiler equipment has a capacity of 450 horse-power, three-phase alternators being operated by the engines with cotton belts. The pressure on the line is 6,000 volts, and the high-tension line, as well as a secondary, three-phase low-tension working, is carried on poles, the first thirty-six feet from the ground and the latter eighteen feet. The pressure of the low-pressure line is 600 volts and substations are located at intervals of three miles along the canal, in which transformers of thirty-six kilowatts capacity are installed.

The electric locomotive or tractor is of the four-wheel type and runs along the towpath without the use of rails. It is supplied with a five-horse-power three-phase motor which will handle a maximum load of twenty horse-power when necessary. This locomotive is about three and one-half feet wide, a trifle less than eight feet long, and weighs about 4,000 pounds. A triple trolley is used, and when meeting other boats the trolleys are exchanged, or the towropes are exchanged and the tractor returns over the same section. Each tractor runs over a section with five barges, each with loads of 20,000 pounds, the speed being two and one-half miles per hour. The current is also sold to factories and other consumers along the canal for light and power service.

In reference to the various systems of electric canal traction, Mr. L. Gerard is authority for the following, calculating the efficiency as the ratio of the power actually developed in the towrope to the electrical power applied. (In *Science Abstracts,* page 657, 1901, from Soc. Belge Elect., Bull.): "The Koettgen rack system on the Finow Canal showed a maximum efficiency of 0.704 when towing a 100-ton barge at 3.75 kilometres per hour, the tractor working up to twenty electrical horse-power at most, with an expenditure of five and three-quarters electrical horse-power running light at 7.5 kilometres per hour. The Denefle tricycle (old form) on the Aire & Deule gave an efficiency of 0.414 when towing a barge of 293 tons at 2.8 kilometres per hour, with a maximum power of 19.2 electrical horse-power. Running light at 3.74 kilometres per hour, the tricycle took 4.17 horse-power. A new pattern of the tricycle gave an efficiency of 0.44 with the same load at 2.64 kilometres per hour. The Gerard tractor gave 0.534 at 3.6 kilometres towing two seventy-ton barges, and took 5.5 horse-power at 4.4 kilometres empty. The Gerard screw propeller system gave an efficiency of 0.322 at 3.2 kilometres, the screw making 375 revolutions per minute when towing two seventy-ton barges, and took 5.4 horse-power at 8.2 kilometres empty. This result is compared with

steam practice for which a maximum efficiency of 0.294 is given." Gerard maintains that with electric haulage a large increase in the number of voyages may be obtained over animal haulage, and the electrical distribution of power for dredging, pumping and other power purposes, as well as for lighting, should not be disregarded in connection with the electrical system.

Both direct-current motors and polyphase alternating-current motors have been used with more or less success for electric canal haulage, not only in Belgium and other European countries, but also in America. Recently electric haulage has been utilized on the Miami & Erie Canal, and this is said to be the first three-phase traction system in the United States. This canal cost, with its reservoirs, about $8,000,000, the latter including the Grand reservoir of 17,000 acres, the Laramie reservoir of nearly 2,000 acres and the Lewiston reservoir of somewhat over 7,000 acres. The canal ranges from four to six feet in depth, and in width from forty to sixty feet along the line from Dayton to Toledo and Cincinnati. The electric haulage on this American canal is largely due to Thomas N. Fordyce. The total distance is about sixty-eight miles and a standard single-track road is provided along the towpath of the canal. From five to seven canal boats are hauled by each electric locomotive, the current being taken from overhead trolley lines, the track acting as the third conductor. The trolley wire ranging in height from seven to twenty-two feet, the former being that used under the various bridges in Cincinnati. The feeders are stranded aluminum wire and the trolley wires are No. 0000 G. E. grooved wires mounted on flexible brackets. The current is supplied from the power plant of the Cincinnati Gas and Electric Company, and has a frequency of sixty cycles and a pressure of 4,000 volts.

At the Spring Grove substation the current is reduced in pressure to 400 volts and, in phase, is transformed by the Scott method of arranging the transformer connections, to two-phase. The voltage of the three-phase on the transmission line along the canal is 33,000 volts, and the frequency twenty-five cycles per second, and to obtain this pressure motor-generators and step-up transformers are employed at the substation. A 300-kilowatt three-phase generator of 390 volts is driven by a 450-horse-power synchronous motor, which is supplied with the two-phase current entering Spring Grove converter station. The 390-volt three-phase current, which then has a frequency of twenty-five cycles, is raised in pressure by 250-kilowatt step-up transformers to 33,000 volts.

Step-down substations are located along the canal line about twelve miles apart, and the current is reduced in pressure from 33,000 volts to 1,090 volts for use on the three-phase canal trolley line. The three transformers installed in the substation are connected in delta and each has a capacity of 150 kilowatts. The substations are sixty feet long, twenty-five feet wide and twenty-five feet high, the basement being seven feet high and the main floor transformer room eighteen feet high. There are seven Baldwin-Westinghouse twenty-ton three-phase locomotives to be used, most of which are now in operation. The drawbar pull is 9,600 pounds starting, the coefficient of adhesion being twenty-five per cent, the voltage on the trolley line 1,100 volts and the frequency of the current 3,000 alternations per minute. The motors are of eighty horse-power capacity each and are wound for 200 volts, which voltage is obtained by further step-down transformers located upon the locomotive. With the two induction motors, operating in tandem, the speed is about four miles per hour, but with one motor only in operation the maximum speed is six miles per hour, and the locomotive will haul a full load ten hours continuously without a maximum rise of temperature of the motors beyond seventy-five degrees. The transformers on the locomotives are arranged with proper connections for supplying the required current to the motors when the trolley circuit has a pressure of 390 volts, which is the potential used within the city limits of Cincinnati for absolute safety.

The results of the Teltow Canal competition are of particular interest and refer to the first cost and the working cost per ton-kilometre on a canal thirty-seven miles in length and with one and one-half million tons of freight traffic per year as a basis. The first cost of the Siemens & Halske system was 2,500,000 marks, and the working cost per ton-kilometre was given as 1.07 pfennigs; and while the first cost of the Feldmann & Zehme system of electric canal haulage was not given, the working cost per ton-kilometre was 0.667 pfennig. The Rudolf system of Kanaltauerei Gesellschaft is given as 2,597,000 marks, and the working cost 0.61 pfennig per ton-kilometre; while the system having the lowest first cost, as well as the lowest working cost, was that of Ganz & Company, of Budapest, Austria-Hungary. The working cost was 0.43 pfennig per ton-kilometre and the total first cost only about 7,000 marks over 1,000,000 marks, or less than half of the first cost of the other systems above mentioned.

With the Ganz system of electrical haulage a monorail track is used and this largely accounts for the low first cost of construction, while the lightness of the locomotives employed for their output, on account of their peculiar construction, undoubtedly has much to do with the excellent showing as to working cost per ton-kilometre. The Ganz tow locomotive was designed by Engineer Fabre and two inclined pairs of axles are provided instead of the ordinary horizontal axles usually employed with two vertical wheels.

With this locomotive as noted in the figures there is an inclined wheel on every axle and each pair of wheels embraces the rail-head, and as there is only a single rail another lateral wheel is provided to back up the locomotive, this wheel operating upon the ground or towpath. By the inclined wheel arrangement the rope pull is utilized to increase the adhesion, and it is also claimed by the engineers favoring this system that the adhesion is also greatly increased by the wedging action upon the inclined axles due to the weight of the two locomotives.

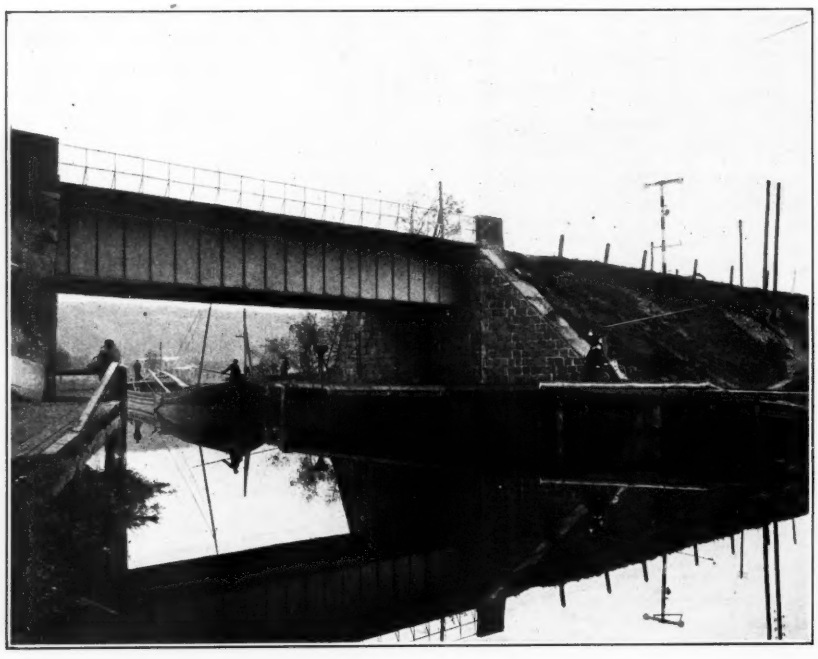
The locomotive was designed for a three-phase current, the motor operating with current of a frequency of fifty periods per second, and on account of the high speed of the motor and the low speed of the locomotive pinion-gearing was employed. It is stated that at fifteen periods per second this pinion-gearing would not be necessary and the motor-shaft could be made to serve direct for driving the worm-wheels. Mr. Szasz gives the following as the fundamental qualities of this locomotive:

"(1) With the use of one rail a very high coefficient of adhesion, and consequently a very light weight locomotive. (2) The utilization of the towrope for the increase of adhesion of the locomotive. (3) Proportional increase of the stability of the locomotive according to the effort put out." In continuing he gives the following data in reference to this locomotive:

"It rests upon one rail only, which differs little in shape from the ordinary Vignoles rail. The two oblique pairs of wheels embrace the lateral and top parts

of the rail-head, a little room being left on the top. The weight of the locomotive rests upon the four oblique axles, being carried on one side by a spring. The motor axle is disposed horizontally, the motor being built into the locomotive frame. Each of the four axles is driven by a worm-gearing apparatus by means of the two endless screw-shafts which are operated from the motor by a toothed gear. The lateral broad supporting wheel serves the purpose of backing up the locomotive and ensuring thereby equilibrium. This wheel is fixed on the side facing the canal, as the inclined towrope tends to tip the locomotive in this direction. If the locomotive represented a rigid system, the force of reaction on the rails causing the adhesion could only be as great as the weight of the locomotive itself, apart from that small part of the weight taken up by the wheel. As the adhesion is to be increased by the wedging action of the weight, it has been necessary to provide for a certain mobility in those parts by which the weight of the locomotive is taken up and transmitted to the rails. For this purpose the locomotive weight can be shifted on the axles. The bearings of only two axles are rigidly built together with the motor, these two axles being on the same locomotive side. The axles on the other side are able to turn around the endless screw-shaft and the locomotive weight rests on this side, by means of springs on the axle. In this way the relative position of the axles and the motor can be shifted in axial direction, and, besides, the axles of the one side can move around the shaft. This mobility of the axles enables the weight to develop the wedging-action."

The Ganz locomotive for towing in the electric system of canal haulage, has a controller, a rheostat, main switch and plug contact for manipulating the three-phase motor. The current is directed to the motor through a flexible cable and trolley contacts, the rail being used as the third conductor. The overhead line consists of two copper wires eight millimetres in diameter and the pressure used is 500 volts. The two contact wires are located 300 millimetres apart and are placed six metres from the ground. The two conductors are supported on wooden poles placed about 100 feet apart.



KOETTGEN SYSTEM OF ELECTRIC CANAL TOWING.

California Petroleum and Its Use as Fuel.

In this interesting article in the current number of the *Journal of Electricity, Power and Gas,* Mr. A. M. Hunt gives a brief history of the development of the California oil fields, and discusses the value of this fuel and its probable extent. Oil was first discovered in California in 1855, but little attempt was made to develop the fields before 1860. In 1870 the annual output amounted to only 3,600 barrels. It has increased steadily from that time until, in 1902, the output was 13,700,000 barrels, valued at about $10,000,000. Practically all the fields which furnish oil in commercial quantities are located south of an east and west line running through the towns of Visalia and Hanford. Within this belt the productive fields are distributed in the foot hills of the Sierras, but the oil-yielding formations are not necessarily confined to the above locality. During the year 1902 many of the wells were shut off, due to the low price of oil and the lack of transportation facilities. Practically all the petroleum of California is asphaltum-base oil. The major part of it is quite heavy, and contains only a small percentage of gasolines and kerosenes. Its value for refining will be slight, and its main use will be for fuel purposes. A gallon of oil weighing 7.88 pounds will contain, approximately, 18,700 British thermal units per pound. The average coast steam coal contains approximately 13,500 British thermal units per pound. A short ton of such coal is equivalent in heat value to four and one-third barrels of oil. Volume for volume, this heavy oil contains as many heat units as lighter oils. Any burner which will distribute oil in a furnace in a state of fine subdivision accomplishes all that is necessary. However, a burner suitable for one type of furnace may not suit in another. The author has for several months been experimenting with a method of burning oil under boilers that has been eminently successful. On the ash-pit floor one or more flues (depending on the width of the furnace) are built, extending from the ash-pit door back to the bridge wall which closes the flues at the rear end. These flues are about six inches square inside, and built of firebrick. The sides are pierced with ports, at intervals of about eight inches. A common burner of the concentric tube type is placed at the front end so as to discharge the oil into the flue. When the burner is started and the oil ignited, the interior of the flue soon becomes heated. The flame issues through the side ports, without any of the blow-pipe effect common to practically all open types of burners. The oil that is not consumed in the flue is gasified in the heated interior, and is consumed in the open furnace, additional air being supplied through other flues. The low price of crude oil has changed the fuel situation on the Pacific coast, and has materially reduced the cost of power produced from steam, making it possible, in some locations and under certain conditions of load-factor, to compete with power transmitted from water power stations.

TRANSMISSION COMMITTEE.

INTRODUCTIONS TO DISCUSSION, TO TAKE PLACE AT THE INSTITUTE MEETING, NIAGARA FALLS, JULY 1.

The following papers are introductions to a discussion to take place at the Institute meeting at Niagara Falls on July 1. They are not intended to be formal or complete papers, but serve merely as a basis or framework for discussion on the subjects with which they deal.

It should be borne in mind that the introductions are written in order to provoke discussion and that there should be no hesitancy in attacking them if they do not agree with the opinions of the contributor. On the other hand, if the contributor agrees with the matter of the introductions, either as a whole or in part, he should state the fact.

It should also be borne in mind that the principal object of this scheme is to enable and encourage those not in a position to attend meetings to take part in the discussion. If one does not feel himself qualified to discuss certain portions of an introduction, but is able to discuss other parts, it is to be hoped he will contribute to the latter.

Contributions to the discussion of these papers should be mailed to Ralph D. Mershon, 29 Broadway, New York, so that they will be received not later than June 20, 1903.

Y OR △-CONNECTION OF TRANSFORMERS

BY F. O. BLACKWELL.

The two alternative methods, Y or △, of connecting transformers to a three-phase system, come up for discussion with every three-phase installation. A general statement of the advantages and disadvantages of both connections, as they appear to the writer, is given here with the hope that those engineers who have had the most experience with power transmission will contribute their views on the subject.

TRANSFORMERS.

Assuming that three transformers are to be used for a three-phase power transmission and that the potential of the line is settled, each of the transformers, if connected in Y, must be wound for $\frac{1}{\sqrt{3}}$ or about fifty-eight per cent of the line potential, and for the full line current. If connected in △, each transformer must be wound for the line potential and for fifty-eight per cent of the line current. The number of turns in the transformer winding for Y-connection is, therefore, but fifty-eight per cent of that required for △-connection and the cross-section of the conductors must be correspondingly greater. The greater number of turns in the winding, together with the necessary insulation between turns, necessitates a larger and more expensive coil for △-connection. The larger coil calls for a longer magnetic circuit and consequently a larger and heavier transformer throughout. This is of no importance when the potential of the coil is low or when the transformer is large and the current high. In fact, in transformers in which the current is heavy it is usual to divide the conductors into several multiple circuits for ease of handling and to avoid eddy current losses that occur when the cross-section of the conductor is too large. A few turns more or less in the winding under such conditions is, therefore, immaterial.

In transformers of small capacity wound for high potential, the cost and weight are both considerably in favor of the Y-connection of the high-potential coils.

Where it is desired to secure the smallest transformers that can be wound for any given potential, the minimum size of wire that can be employed in the windings of the high-potential coils and give sufficient mechanical strength, is the limiting feature. A small transformer is, therefore, practicable for Y-connection and can be commercially considered for △-connection.

The Y-connection requires the use of three transformers, and if anything goes wrong with one of them the whole bank is disabled. With the △-connection, one of the transformers can be cut out and the other two still deliver three-phase power up to their full capacity; that is, two-thirds of the entire bank.

Combined three-phase transformers are generally of small size and on that account are preferably Y-connected on the high-potential side.

GROUNDING THE NEUTRAL.

If the common connection of transformers joined in Y is grounded, the potential between windings and the core is limited to fifty-eight per cent of that of the line, and the insulation between the windings and the core might be proportionally reduced. The same argument applies to the transmission circuit and would allow the size of the line insulators to be reduced.

The saving that can be made in insulating transformers by grounding the neutral is not great with large transformers, but is important in small ones, as the space taken up by the insulation for any given potential is relatively greater in a small transformer. Under normal conditions, the potential between any conductor of a three-phase transmission circuit and the ground is fifty-eight per cent of the line potential, with either Y or △-connection, but the neutral may drift so as to increase the potential with an ungrounded system. If one branch is partly or completely grounded, the potential between the other two branches and the ground is, of course, increased and may be the full line potential. With a grounded neutral Y-system, a ground is a short-circuit of the transformers on the grounded branch and the transmission becomes inoperative.

From the point of view of safety to life and prevention of fires this is a desirable condition, especially if the low-tension distribution is also grounded. If the high-tension circuit makes contact with the ground or low-potential system, it can be immediately cut out by fuses or automatic circuit-breakers.

The difficulty is that a power transmission is likely to be frequently shut down by temporary grounds, such as would be caused by a tree blowing against one of the wires. Even if the circuit is not opened, the drop in the pressure due to the sudden "short" on the line will cause synchronous apparatus to fall out of step. Under the same conditions a system without a grounded neutral would give uninterrupted service.

UNSTABLE NEUTRAL.

If two transformers are connected in series, there is no certainty that they will divide the potential equally between them. A system in which all the electrical apparatus is connected in Y has somewhat the same characteristics. The neutral may drift out of its proper place and there will be unequal potentials between it and the three conductors of the circuit, due to unequal loading and differences in the transformers or transmission circuits. Such unbalancing would cause unequal heating of the transformers, and, if a four-wire three-phase system of distribution were employed, would seriously interfere with the regulation of the voltage. If transformers, therefore, have Y-secondaries, it is desirable that the primary should be △-connected. Two systems in common use with which △-primary windings should be used, are shown in Figs. 1 and 2.

RISE OF POTENTIAL.

The high-potential windings of transformers are necessarily of high reactance,

and if left in series with a circuit of large capacity, as shown in Figs. 3, 4, 5 and 6, the leading charging current flowing over the reactance may set up extraordinarily large pressures. Figs. 3 and 4 represent Y-connected banks of three transformers, each connected so as to cause such a rise

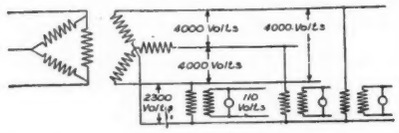


FIG. 1.—STEP-DOWN TRANSFORMER FOR 4,000-VOLT Y-DISTRIBUTION.

of potential. In Fig. 3 the primary of one transformer is excited by a generator, the primary of the other two transformers being open-circuited. In Fig. 4 the primary of one transformer is open-circuited, the other two being connected to the generator. Figs. 5 and 6 show T-connected banks of two transformers, which might be used to transform from either two-phase or three-phase to three-phase or *vice versa,* and are similar in action to Fig. 3. If in any one of Figs. 3, 4, 5 or 6 the secondaries are connected to a long-distance transmission circuit, a pressure of many times the normal potential will be set up between A and B, and between B and C, that between A and C not being affected.

It is theoretically possible for a potential 100 times that for which a transformer is wound, to be caused by opening the primary switches of one or more of the transformers of a bank connected in Y before the secondary switches are used. Of course, actually, the current jumps across the insulation at some point in the system before there can be any such increase in pressure. If there are a number of banks of transformers in parallel, this phenomena can not occur except when all but one bank are disconnected. This source of trouble could be obviated by employing oil switches on the high-potential side, which disconnect the line before the low-tension switches are used, or triple-pole switches on the primary, which open all three branches of the bank of transformers at once.

The selection of Y or Δ-connection of transformers for long-distance transmissions should only be determined after a careful consideration of the conditions in each case.

There is little choice between Y or Δ without a grounded neutral.

In small installations, the cheaper cost of transformers for Y with a grounded neutral will be a determining factor. Larger plants will be guided by the greater importance of giving uninterrupted service and will not employ a grounded neutral unless demanded on the score of safety.

Where the amount of power is great and the system extensive, Δ-connection will be generally preferred on account of its avoiding the possibility of rises of potential from any cause. Many plants can have advantageously a mixed system with both Y and Δ-transformers, each installation of transformers being considered by itself.

CHOICE OF FREQUENCY FOR VERY LONG LINES.

BY P. M. LINCOLN.

Although other frequencies are in use in this country, there are only two which by the extent of their use can be called standard, *viz.,* sixty and twenty-five cycles

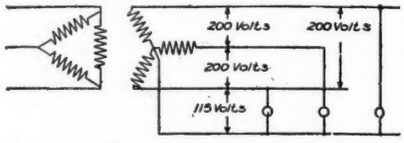
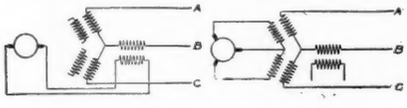


FIG. 2.—STEP-DOWN TRANSFORMER FOR 200-VOLT Y-DISTRIBUTION.

per second. Without discussing the relative merits of other frequencies, the question now presented is, which is the better frequency for a very long line, sixty or twenty-five cycles per second, considered purely as a transmission problem.

In the present state of the art, 200 miles may be considered as very long for a transmission line. Although longer ones have been proposed, only one of this length has been put into actual operation and no other line approaches this length. The reasoning which follows will, therefore, be made to apply to a typical line 200 miles long.

Frequency has a direct bearing upon voltage regulation and charging current

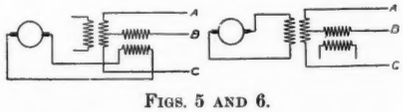


FIGS. 3 AND 4.

and its influence on a possible condition of resonance may also be profitably discussed.

(1) Voltage Regulation—The difference between the voltage at the transmitting and the receiving stations, termed the "drop," is dependent upon several elements, among which are the resistance and the inductance of the circuit. The volts for overcoming the resistance are the same as would be required for sending a direct current equal to the normal alternating current through the line, if it be short-circuited at the receiving end. The volts for overcoming the inductance at any frequency are measured by the pressure which would be required for sending the alternating current at that frequency through the short-circuited line, if the ohmic resistance were negligible. The inductance volts are directly proportional to the frequency. The difference in voltage between the transmitting and receiving stations, or the "drop," is a function of the resistance volts, the inductance volts and the power-factor of the load.

Consideration of voltage regulation at the receiving end limits, according to best practice, the resistance volts in a transmission line to about fifteen per cent as a maximum, and the same consideration should keep the inductance volts within a maximum of twenty per cent. This will mean a line reputation of about twenty-four per cent with a load power-factor of eighty-five per cent. Best economy may reduce the resistance element below the maximum given. The resistance volts may be reduced to any given amount by the addition of copper, while inductance volts are little affected by increasing the size of wire. An increase in size of conductor which will reduce resistance volts by one-half will reduce inductance volts only about five per cent. The matter of inductance volts, therefore, constitutes a



FIGS. 5 AND 6.

limit to the amount of power that can be delivered over a single line. This consideration will limit the amounts of power which can be delivered by a three-phase line 200 miles long to approximately the following:

TABLE SHOWING LIMITS OF TRANSMISSION LINE CAPACITIES.

Voltage at Receiving End. Two-Hundred-Mile, Three-Phase Line. Volts.	Power Delivered with Twenty per cent Inductance Volts.	
	60 Cycles. Kilowatts.	25 Cycles. Kilowatts.
20,000	500	1,250
30,000	1,125	2,800
40,000	2,000	5,000
50,000	3,125	7,800
60,000	4,500	11,250
80,000	8,000	20,000

For longer or shorter lines the kilowatts in the above table may be decreased or increased in direct proportion.

If the amount of power to be transmitted is large, the multiplication of lines necessary at sixty cycles unduly increases expenses both of pole lines and of right

of way for same. This point is evidently in favor of the lower frequency.

(2) Charging Current—Charging current is, of course, a direct function of frequency and voltage and to a slight extent of line construction. At sixty cycles the apparent energy represented by the charging current in a 200-mile three-phase line is practically equal to the ultimate capacity of that line as limited by the twenty per cent inductance volts consideration. At twenty-five cycles it is only about fifteen per cent of the ultimate capacity as limited by the same consideration. In a sixty-cycle installation, therefore, it is necessary either to operate the generators on such a line at about full current output all the time, no matter what the load, or to compensate for the charging current in part or in whole by the installation of choke coils, either horn of which dilemma is not pleasant to consider. The problem of taking care of the charging current at twenty-five cycles does not enter the discussion as compared with sixty cycles.

The effect of a large charging current on the regulation of the generator should also be considered. As is well known, a line charging current, when circulating in a generator armature, has the effect of assisting the field ampere-turns to magnetize the fields. The percentage of magnetizing done by this charging current depends upon its amount and the inherent regulation of the generator. Since the charging current depends upon the voltage, the generator exciting power of the charging current also depends upon the voltage. The effect of sudden load changes, therefore, which tend to change the voltage delivered, will in turn affect this element of the excitation. That is, to a certain extent, the generator assumes the regulation which inherently belongs to a direct-current shunt generator. The effect of large charging currents on generator regulation is, therefore, not toward an improvement.

(3) Resonance—As is well known, every combination of a condenser and choke coil in series has a natural period of oscillation, whose value depends upon the square root of the product of the condenser capacity by the choke coil inductance. If a frequency of its natural period be applied to such a combination, reasonance will occur. That is, a small exciting force of the proper frequency will cause comparatively large currents to circulate between the condenser and the choke coil and, therefore, comparatively large voltages across both the condenser and choke coil. This is an example of reasonance in its simplest form.

A transmission line possesses both capacity and inductance, and therefore the possibility of becoming reasonant under certain conditions. The fact that both the capacity and inductance of a transmission line are distributed throughout its entire length, and the disturbing effect of concentrated inductances and capacities at transmitting and receiving stations, makes the problem of determining under what conditions resonance will occur an extremely intricate one. A first approximation may be obtained, however, by assuming that the inductance and capacity of a line are concentrated instead of distributed, and omitting the effects of translating devices. Under this assumption, we may consider that the capacity of a distant portion of the line is in series with the inductance of the intermediate portion.

The natural period, that is, the applied frequency at which resonance will occur between the two parts of a transmission line, will be a minimum when the two parts are equal, or each is equal to one-half the total line. The number of natural periods above this minimum is infinite, since it is possible to divide the line into two parts, the inductance of one of which multiplied by the capacity of the other may be any quantity less than that obtained by dividing the line into two equal parts.

The minimum period of a 200-mile line is approximately 200 cycles per second. There is, of course, no danger that the fundamental applied frequency will produce resonance until the length of line largely exceeds 200 miles, but the same can not be said of some of the harmonics if they are sufficiently prominent. The lower the fundamental frequency, the less is the danger from this source. So far as the writer is aware, no actual trouble has ever been experienced in existing plants from this source even on the longest lines and highest frequencies in use, but it nevertheless constitutes an advantage for twenty-five over sixty cycles that can not be dismissed with a scoff.

It is a fact that the longest transmission line in the world—the Bay Counties line in California—as well as the highest voltage line—the Missouri River Power Company in Montana—are both operating at sixty cycles. This fact, however, does not detract from the force of the preceding reasoning.

It is not claimed that this discussion contains all of the arguments pro or con. The bringing out of additional points, as well as the soundness of those presented, is left to the discussion which it is hoped the above will provoke.

Electrical Dispersion at Vesuvius.

Herr Heinrich Freiherr Rausch von Traubenberg, the author of an article on this subject in a recent number of the *Physikalische Zeitschrift,* spent several days at the Vesuvius astronomical station, making experiments upon the discharging power of the ionized air from the neighborhood of Vesuvius. The measurements were made by an electroscope of the same type as that used by Elster and Geitel. This was protected by a wide-meshed wire net, which allowed free circulation of the air. Within a room this apparatus showed a positive discharge rate of about one volt, and in a cellar, of about ten volts. On a castle in the neighborhood of Freiburg, with a light wind and clear weather, the discharge rate was between eight and twenty volts in ten minutes. The intensity of the initial charge for all of these measurements was 135 volts. The first day at Vesuvius, measurements were made on an open platform. The weather was clear and bright, and there was a fairly strong wind blowing from the direction of the crater. The tests were made during the afternoon. A position unprotected from the wind showed a positive discharge rate of 116 volts and a negative of 106 volts in ten minutes. At a position perfectly protected from the wind, a positive discharge rate of fifty-one volts and a negative of fifty volts in ten minutes was observed. About six o'clock in the evening a positive rate of discharge of 100 volts and a negative of 475 volts in ten minutes was observed. The electroscope showed such a rapid rate that accurate measurements were not possible. The effect appeared to be very different at different moments. The volcano was fairly active, giving out thick smoke clouds and much steam, which at night reflected the light from the glowing mass within the crater. The following day and the day after the work was interrupted by continued rain and heavy storms. An attempt to conduct experiments nearer the crater was unsuccessful on account of the explosions and the discharge of stones. One of the measurements, made in a cloud of steam and sulphur vapors, appeared to show a strong discharge rate, but this measurement could not be considered reliable.—*Translated and abstracted from the Physikalische Zeitschrift (Leipsic), May 15.*

Reception at Johns Hopkins University.

A reception and garden party were tendered at Homewood, Johns Hopkins University, Baltimore, Md., on Friday, June 5, from five to seven o'clock. This reception was held in order that the contributors to the endowment fund of the university might be brought together.

The Exchange of the Ashtabula Telephone Company.

Description and Illustrations of a New Equipment at Ashtabula, Ohio.

THE Ashtabula Telephone Company has recently reequipped its exchange in respect to telephones and central office equipment, at Ashtabula, Ohio, and has now, it is claimed, one of the finest exchanges in the state.

This company was organized in 1896, and is composed of the leading men of the city, and the growth has been so rapid that the exchange is to-day several times larger than was first considered possible.

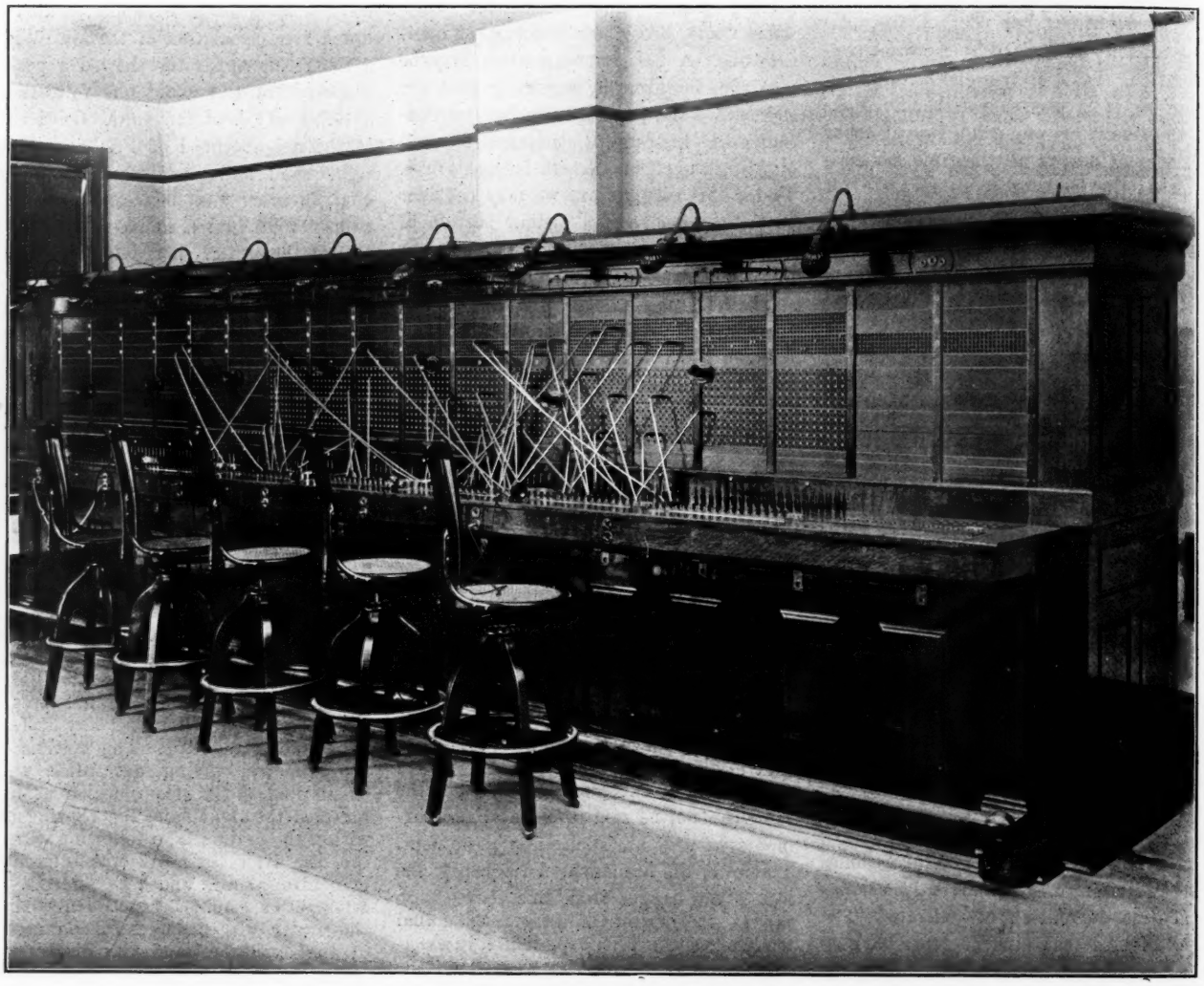


FIG. 1.—LAMP SIGNAL, COMMON BATTERY, MULTIPLE SWITCHBOARD, ASHTABULA TELEPHONE COMPANY, ASHTABULA, OHIO.

After having outgrown several switchboards, as well as the outside construction, a contract was placed with the North Electric Company, of Cleveland, Ohio, for a complete new equipment for its central office. The switchboard ordered was of the lamp signal common battery, multiple type. This is shown in Fig. 1.

This switchboard has a capacity of 1,800 lines, with an installed line equipment of 1,000 local common battery lines. There is also a separate position on the board, equipped for magneto rural lines, which class of service the Ashtabula Telephone Company has been recently covering. As will be noticed in the illustration, the first or annex position is reserved for the necessary multiple jacks; the second or magneto position, generally known as "B" position, is equipped with fifty magneto drops, for taking care of the rural lines. The operator at this position has within her reach the multiple of every line on the entire switchboard. This position is equipped with party line signaling apparatus, so that the operator can selectively signal any of the subscribers on her section.

The third position on the board, known as the "switching" or second "B" position, is equipped with a duplicate of all toll-drops, as well as with the necessary trunks for handling the toll traffic during the day time. At night the toll service is switched from the separate toll-board to the switching position on the main board, so that the night force can handle the entire traffic of the exchange at one point. The switching position is also equipped with busy back signals, so that any subscriber's line, which is temporarily in use, can be easily reserved and held for any long-distance work that may be required.

The next five positions, know as "A" positions and equipped with local lines, are arranged with 200-line equipments to each operator. This has been considered an unusual number of lines for one operator to handle, but the experience at Ashtabula has demonstrated beyond a ques-

tion the claims that 200 lines can safely be handled by expert operators and give first-class service. While the service average per line on this exchange is above the average for its size, nevertheless a three-second service is maintained, which telephone men will readily concede is above the average results obtained. Each of the "A" positions is equipped with the necessary cord equipment, including party line keys and with supervisory signals for each cord pair, so that the operator can at all times tell automatically whether a subscriber has answered a call, whether either one has finished, and whether either one is demanding a subsequent call. In addition to this she can selectively signal any party line subscriber with whom she has occasion to connect. This makes this board particularly attractive for work in exchanges of the character mentioned.

The switchboard is of golden oak, mounted upon a substantial iron rack, all work being put into it in such a way that additions can be made without any changes in the wiring.

The chief operator's desk, which is not shown, is equipped with all the necessary listening taps and apparatus for the chief operator to handle the force working under her. In addition to this her desk is equipped with observation lines, so that any lines needing special attention can be covered.

In Fig. 2 is shown the terminal room. Here are located the main and intermediate distributing boards, as well as the relay racks. To the line side of the main distributing rack are brought all of the outside cables, while on the switchboard side are located the protectors. The intermediate distributing board is also of the open iron rack construction and of the latest design. The relay racks on the right are strong and substantial, the relays being so mounted that all parts are accessible. All relays are enclosed in individual dustproof cases. In this room is also located the wire chief's desk, equipped with meters, switches, plugs, keys and all other apparatus necessary to enable him to test any of the lines in use in the exchange.

The most important part of common battery, central office equipment is the power plant. A very complete and elaborate power switchboard has been installed. This power board consists of three panels of Tennessee marble, mounted in a substantial iron rack, the panels being equipped with all fuses, switches, circuit-breakers and Weston meters. The work in the rear of the power board is very substantial and heavy, and would take care of the currents required if the exchange were several times its initial size. Very heavy and substantial switches are used on this power board, the work being designed to meet the most trying requirements.

The entire power plant is in duplicate. The generators, Fig. 3, are mounted upon a pedestal which is filled with sand, taking away the noise and vibration ordinarily incident to power plants of this construction. The charging machines are of the Holtzer-Cabot make, and are designed to work off of the various power plants available at this centre. The charging machines are in duplicate, so that in the event of a breakdown of one power circuit the other is available. The ringing machines are manufactured by the same company, one being equipped to work off of the power circuit and the other off of the batteries. It will be noticed that each individual machine bears its number, which corresponds to

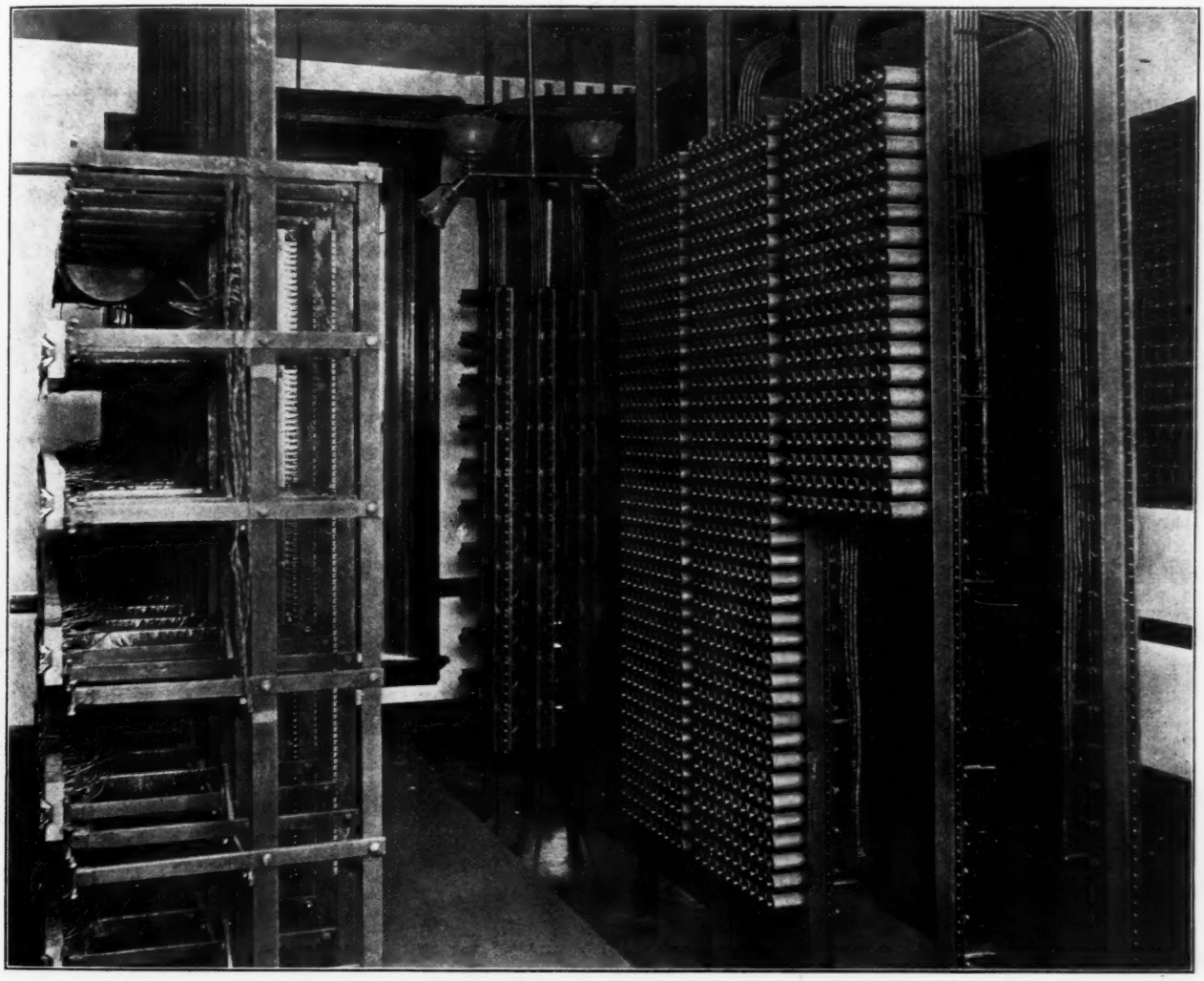


FIG. 2.—THE TERMINAL ROOM, ASHTABULA TELEPHONE COMPANY, ASHTABULA, OHIO.

the switches and other apparatus on the marble power board.

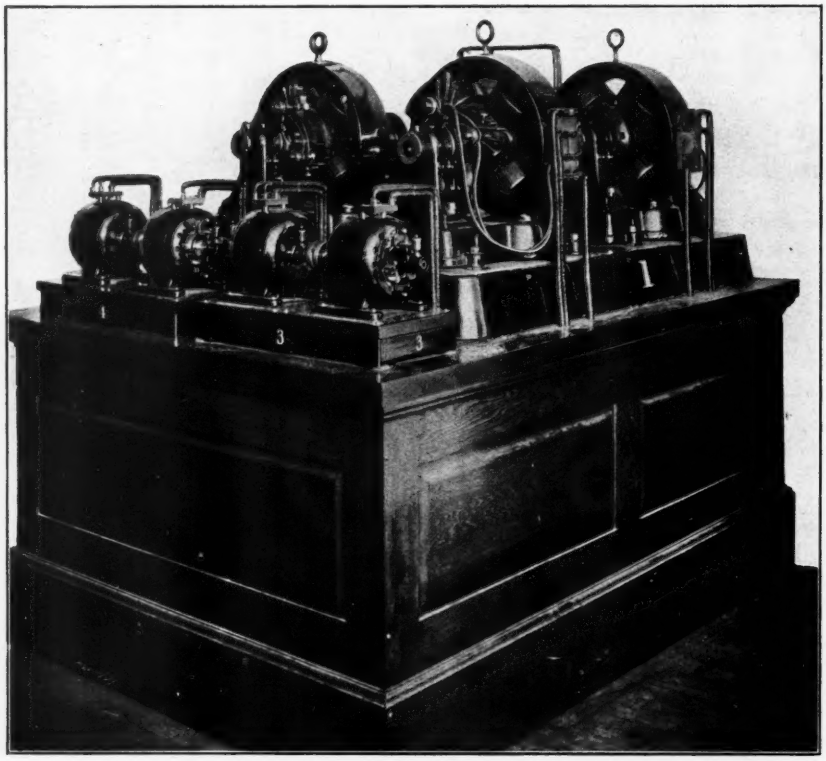


FIG. 3.—THE POWER PLANT, ASHTABULA TELEPHONE COMPANY, ASHTABULA, OHIO.

Fig. 5 shows the storage batteries, which are in duplicate, mounted upon angle iron racks of substantial construction. They are the chloride accumulator type, and each set of ample capacity to handle the exchange for twenty-four hours when running to its full capacity. The wiring to the cells is such that an individual test at the power board can be made of each cell, or each set of batteries can be tested in unison. The power wiring is put in in such a way that there is absolutely no charging induction. The storage batteries are set in a separate room, in which ample provision is made for taking care of the fumes, by proper ventilation.

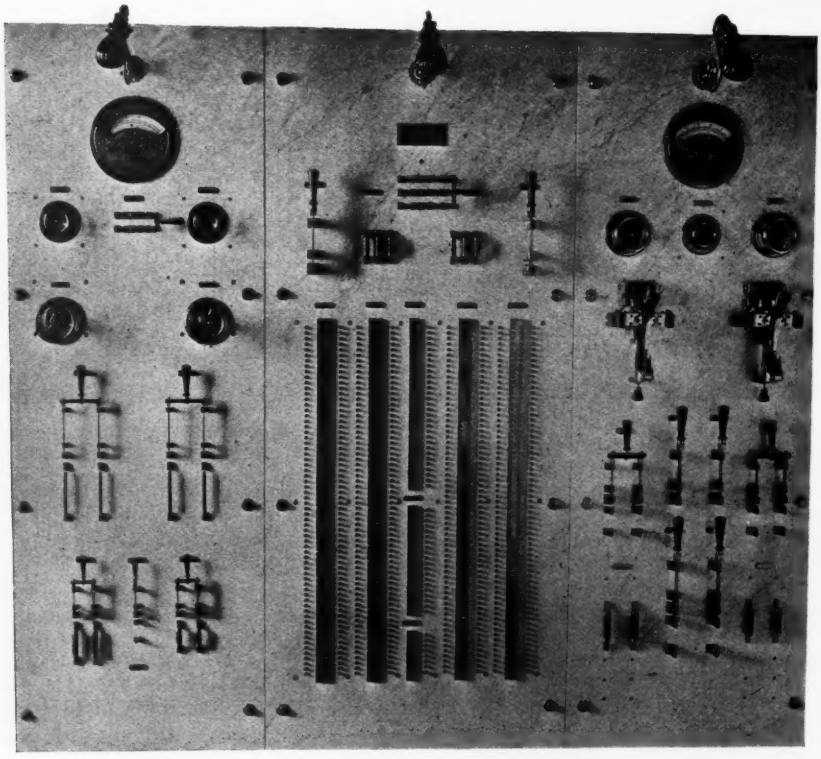


FIG. 4.—THE POWER BOARD, ASHTABULA TELEPHONE COMPANY, ASHTABULA, OHIO.

The toll-board, which is situated in a separate room, is connected by a complete automatic trunking system in such a way that the signals between the toll-board and the main board are automatic; the toll-operator having complete supervision over all toll-calls.

The Ashtabula company has a branch exchange located at Ashtabula Harbor, the board being for 300 lines, on which is handled a great many party lines. This board is connected to the main exchange by several incoming and outgoing trunks having automatic signals, all trunks terminating on the second "B" or "switching" position. This gives a complete supervision of all trunk connections by the switching operator.

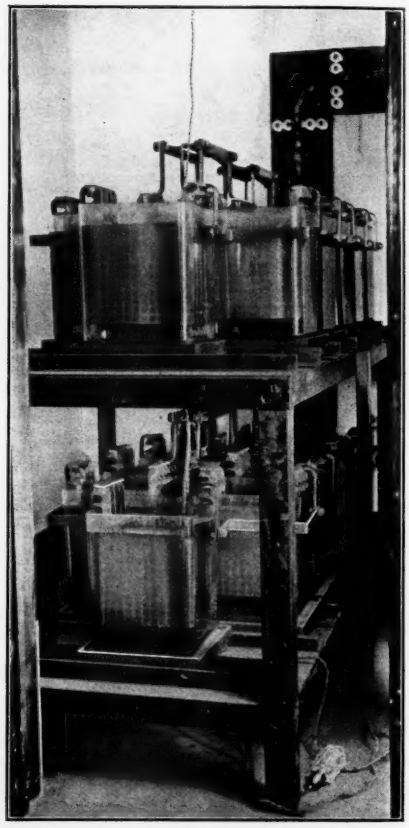


FIG. 5.—STORAGE BATTERIES, ASHTABULA TELEPHONE COMPANY, ASHTABULA, OHIO.

In the installation of this equipment every precaution has been taken to give the operators and the force handling the traffic the most complete equipment for the giving of modern service, and visitors who have inspected this exchange are loud in their praises.

The Ashtabula Telephone Company erected its building, investigation proving this to be the most advisable course. The exchange is provided with workshop, inspectors' room, stockroom, operators' retiring room, and everything necessary for the handling of the business. There are in addition to this the general office, directors' room, as well as the counting office.

The Twenty-sixth Convention of the National Electric Light Association.

Proceedings of the Sessions Held at the Auditorium Hotel, Chicago, May 26, 27 and 28.

TUESDAY MORNING SESSION.

PRESIDENT Louis A. Ferguson, of Chicago, called the twenty-sixth convention of the National Electric Light Association meeting to order at 10.15 A. M., on Tuesday morning. He announced that it was expected that the Hon. Carter H. Harrison, Mayor of Chicago, would have welcomed the delegates, but owing to business engagements he was unable to do so. In place of the address of welcome by the Mayor, Mr. Edward B. Ellicott, city electrician, forwarded the following resolution which had been passed by the City Council at its meeting on Monday, May 25:

WHEREAS, The National Electric Light Association will hold its twenty-sixth annual meeting at the Auditorium Hotel in Chicago, beginning Tuesday, May 26, 1903; and

WHEREAS, Those attending will represent the electric light interests of this country; be it hereby

Resolved, That the members of this council wish the delegates a successful convention, and authorize his honor, the Mayor, to extend to them during their visit the freedom of the city of Chicago.

On motion of Mr. Insull, it was ordered that a suitable acknowledgment of the resolutions be sent to the Mayor of the city.

President Ferguson then delivered an address, saying, in part:

The year just closing with this convention has been an unusually active one for the officers of your association, as there have been many important matters presented requiring their attention.

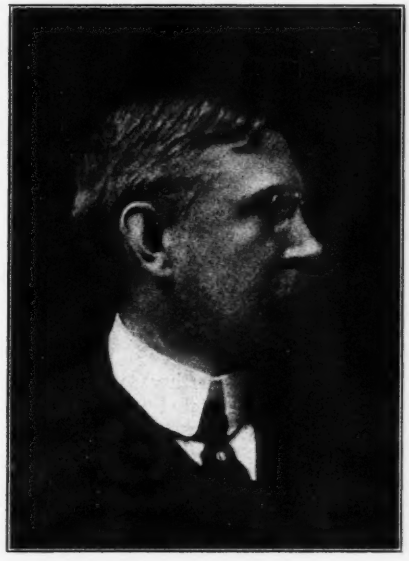
Through persistent canvassing, the membership of the association has been increased in one year more than 225 per cent, until now we number in our active and associate membership list 532 members, 452 of whom are active and eighty associates, besides twenty-six honorary members. The association has become in one year even more national in its character, and its importance and value are becoming more generally recognized.

It has been customary in the past for the president in opening the convention to review the development of the art during the year, but we shall this year depart from the usual custom, following the suggestion of our president of last year.

At the last convention there was considerable discussion on the subject of the relation between manufacturers and central station companies, and I am pleased to report that through our personal efforts in taking up with the manufacturers individual cases as they arose, we have found all the manufacturers willing to co-operate with us to all reasonable extent. We have been very successful this year in handling several cases of unfair competition, when they have been brought to our attention, and in no instance where our assistance has been requested have we failed in protecting the interests of our member companies.

The committee on standard rules for electrical construction and operation has been called upon this year for unusually active work in connection with the "National Electrical Code." Certain changes in the rules for overhead construction had been proposed by a committee of the National Underwriters' Electrical Association, and were under consideration by a committee representing the American Institute of Electrical Engineers. Feeling that some of the proposed changes in the rules were impracticable, objectionable and unfair to the member companies of this association, your president communicated with the president of the American Institute of Electrical Engineers, and urged postponement of favorable action on these changes until they might be considered by the National Electric Light Association. The request was granted, and your committee on standard rules for electrical construction and operation was invited to attend the future joint meetings of the committees of the National Underwriters' Electrical Association and of the American Institute of Electrical Engineers.

Two meetings were held in Boston, one in February and one in March, at both of which your committee and your president were in attendance and took an active part. Your committee took the position that no changes could be made in these rules without a meeting of the conference, consisting of representatives of all associations interested in the subject, as follows: American



MR. CHARLES L. EDGAR, BOSTON, MASS.
PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, Underwriters' National Electric Association.

This position after considerable argument, was sustained, and as a result of the efforts of your committee, assisted by the committee from the association of Edison Illuminating Companies and the American Institute of Electrical Engineers the underwriters removed many of the objectionable features in the proposed changes of the rules.

The reestablishment of a conference—after an inactivity of five years or more—to finally settle all questions of rules of the National Electrical Code is of prime importance to the central station companies of the country, and it will prevent the establishment of rules by the underwriters which might seriously injure the electrical interests of the country and retard the development of the industry.

The necessity for closer relations with other associations of kindred character was shown by the joint work of the committees of the National Electric Light Association and the Association of Edison Illuminating Companies, in the matter of the National Electrical Code. The American Institute of Electrical Engineers, whose membership is made up largely of purely technical men, may lay down some rules, or the National Bureau of Standards may adopt some standards of measurement, which, while they may appear good from a purely scientific standpoint, may be exceedingly bad from the business standpoint of the members of this association.

There is probably no piece of apparatus in the construction of the central station at the present time, the results of which are awaited with such keen interest by central station managers as the steam turbine. It seems wise, therefore, that we should not rest with the information given us at this convention, but we should appoint a committee of three good mechanical engineers to follow the development of the steam turbine during the coming year and report the results at the next convention.

There is a growing demand for electric power in factories, and it is important to central station companies that this business should be obtained for their service. Statistics showing the useful and economical application of electricity in factories, together with costs at various rates per kilowatt-hour, are not readily obtainable, and I would recommend the appointment of a committee of three men from different sections of the country, to gather statistics on "purchased electric power in factories," and report at the convention, or sooner if found feasible.

On motion of Mr. Doherty it was voted to refer the address of the president to a committee of three for consideration and report at a later meeting.

President Ferguson announced that this committee would be appointed at a later session.

President Ferguson announced that the secretary, Mr. James B. Cahoon, had been compelled to resign his office on account of ill health; that he had appointed Mr. Ernest H. Davis, of Williamsport, Pa., to act as secretary until the expiration of the term, June 1, 1903, when the incoming president will appoint a permanent secretary.

Secretary Davis read letters of regret at their inability to attend the meeting from the following gentlemen: C. F. Brush, Cleveland, Ohio; Professor Elihu Thomson, Lynn, Mass.; Thomas A. Edison, Orange, N. J.; Carl Hering, Philadelphia; C. H. Mortimer, secretary Canadian Electrical Association, Toronto, Canada; Professor Edward L. Nichols, Ithaca, N. Y.; Professor Henry T. Bovey, McGill University, Montreal, Canada; Professor J. R. Angell, president University of Michigan; Professor Henry S. Carhart, University of Michigan; Professor E. A. Birge, president University of Wisconsin; Professor S. P. Breckenridge, professor of mechanical engineering, Urbana, Ill.; W. H. Merrill, electrician National Board of Fire Underwriters, Chicago; C. M. Goddard, secre-

tary Underwriters' National Electric Association, New York; ex-President M. J. Francisco, Rutland, Vt.; William R. Harper, president University of Chicago; Professor Harris J. Ryan, Cornell University, Ithaca, N. Y.; ex-President Edwin R. Weeks, Kansas City, Mo.; Professor A. E. Kennelly, Harvard University, Cambridge, Mass.; R. S. Kelsch, Montreal, Canada.

The report of the Committee on Progress was made by Mr. T. C. Martin, of New York. Some twenty topics were taken up in the report. The chief features of interest were the comparisons between our own industry and that of the gas industry; the introduction and application of the Nernst lamp; the possibilities and actualities of electric heating; the present inadequacy of electric motor drive; the possibilities connected with the steam turbine.

Mr. Walter M. Anthony, of Chicago, read the report on "Office Methods and Accounting," upon which there was an extended discussion.

TUESDAY AFTERNOON SESSION.

The meeting was called to order at 2.10 P. M., the first business of the session being the paper by Mr. Sidney Hosmer, of Boston, entitled "Advantages to Be Derived from Consolidation of Electrical Interests," which was read by the author.

Mr. Peter Junkersfeld, of Chicago, in discussing this paper said that the question of doing away with and shutting down the machinery in the existing stations is better understood than formerly. In fact, with the present state of the art, this machinery in the old stations operated during a few hours in a few months of the year, is worth just as much to a central station management as the equivalent capacity in machinery in a new station. The matter of reliability of service rendered is a point often disputed, whether or not with a large station we can secure and guarantee the same reliability as formerly. That, of course, in a large station means a great deal better class of machinery and better class of construction work than has heretofore prevailed, and the reasons for which are obvious. Part of these, however, through the use of storage batteries, and the subdivision of the station, and the manner of controlling the service. He thought that this part of the proposition had been outlined very clearly and that the tendency toward subdividing the station must inevitably grow.

Mr. John W. Lieb, Jr., said he would like to emphasize one or two points that Mr. Junkersfeld had referred to; that is the influence of unproductive labor and secondary labor costs in the multiplicity of small stations, as against one large power plant. In advancing from a number of small plants which have been supplying a system, to one central power plant, he thought that if these plants have been turned over, as is usually the case, without providing for the protection of the current by tie lines and other precautions against failure of service, it will be of extreme importance in a large centralized power plant to guard with more than usual care against failures and interruptions of service. While the liability to failure of transmission lines or underground systems is probably not as large as is often claimed, and the destructive effects of high-potential arc are not as severe as would perhaps be imagined on account of the lesser amount of current involved, yet the stability of the system as a whole, and the liability of surgings arising in the system, and the developing of resonant effects, are such as to make it necessary to use very unusual precautions for protection against breakdowns, and in addition to the usual methods of duplicating paths followed by underground transmission lines, secondary connections should be established from station to station, to afford additional paths for assistance between distributing stations. It is probably true that the best arrangement and the relation of substations to such a true central station have not been fully developed; whether a single-bus or two-bus operation, as a usual thing, is the better, or the possibility of separation by means of switch-gear, or a still further separation into practically single-unit operation to a group of substations, the future only can say. But it is probable that supplying each substation through independent sets of feeders, following two courses and not having the central station in itself so arranged as to secure two-bus operation, will supply a reasonable amount of safeguard without detracting too much from the economies to be obtained from true multiple-bus operating.

There being no further discussion, the paper on "Boiler and Furnace Efficiencies," by Mr. A. Bement, of Chicago, was read.

Mr. W. L. Abbott, of Chicago, said the question of boiler and furnace efficiency has been his hobby for several years. He thought that a large proportion of the heating surface of the boiler is lying dormant, and that the remaining portion of the boiler, which is in service, is being overworked to such an extent that we get comparatively poor efficiency from the boiler; that is, in comparison with what we would get if the boiler were so arranged that all the heating surface was brought into use. He would state the proposition in another way—if all the heating surface of the boiler was brought into use, we could use the boiler to a much greater capacity with the same efficiency than we ordinarily do.

Mr. John W. Lieb, Jr., of New York, said that the New York Edison company, in its Waterside station, has some of the furnaces equipped with the Roney stokers on which soft coal in mixture is used, and three furnaces on which the No. 2 or No. 3 buckwheat is used, and while, of course, the grate surface required in the case of No. 3 buckwheat to get sufficient evaporation from the boilers is greater than that in the case of the furnace using bituminous coal, the commercial efficiency of the furnace is very considerably greater in the furnace using No. 3 buckwheat, with hand-firing; the evaporation being higher per dollar, including repairs and maintenance charges on the furnace and stoker equipment. Some years ago, in considering rates of evaporation and furnace efficiencies for hard coal conditions only, an estimate was made to determine to what extent it was desirable to force boilers using the steam sizes of hard coal. In the conditions that were prevailing in New York city at that time, which is some three or four years ago, a very large percentage of the total capacity of the plant was called for but a small number of hours per year; if he remembers the figures correctly, something like twenty-five per cent of the total capacity of the plant was called for considerably less than one hundred hours in the year. That being the case, it is possible, in order to get the extra capacity during these short periods, to be able to sacrifice very considerable economies in order to obtain capacity, and under such conditions it has been found economical to force the boilers on these peak conditions, lasting such a small number of hours per year, to increase the evaporation from 80 per cent to 100 per cent above the boiler rating, giving rates of combustion of thirty, thirty-five and forty pounds per square foot of grate per hour by putting forced draught under the boilers of as much as one, one and one-half or two inches of air pressure, and under these particular conditions using anthracite grates, there was no inordinate or unusual depreciation in the boiler or furnace, or in the tubes; and it was felt that the commercial efficiency of the furnace under these conditions was such as to make it worth while to do a very considerable amount of forcing during that small period. He would ask Mr. Bement whether the curves referred to are plotted from actual observation or not.

Replying to a question, Mr. Bement said that the most economical capacity will be that point where the air supply is utilized so that with western bituminous coal, which burns very fast, it will take more coal to utilize the air supply, and the capacity will be larger. The boiler people sometimes have trouble. In the West they can put in a plant which will give so much horse-power, and they try the same plant in the East and can not make it go with anthracite coal. With a large air supply, the larger the excessive air running up the chimney, carrying away heat, it is better to put in the coal and make more fire.

Mr. Alex Dow, of Detroit, said that he thought it was in order, in this connection, to accentuate the fact, as Mr. Lieb found in New York, that a furnace can not be designed or a stoker selected which will give equal efficiency with coals radically different in their chemical properties, such as the small size anthracite and the bituminous coals. He thought it also in order to accentuate the fact that there are many different kinds of bituminous coal. A furnace designed to give

the highest efficiency must, as the very first condition, have prescribed for it the kind of fuel it is to burn. You can not even exchange between two grades of bituminous coal and get similarly good results. The free burning coals such as are used in the economy tests given by Mr. Bement, Wilmington coal and others of that class behave entirely different in a furnace to the West Virginia coking coal. They require different proportions of combustion chambers and different handling on the grates. It is recognized in hand-firing that the coking coals must be worked on the grates. It is recognized also that these free burning coals must not be worked too much, but fed with a definite thickness and allowed to flame freely. Coals with high carbon can be burned with a comparatively small combustion chamber, because the combining of the carbon with the oxygen is completed promptly, but long flame coals require high-combustion chambers. One of the advantages pertaining to the tile furnace construction, is that it provides a hot, long and large combustion chamber for the free burning coal burned in Chicago and which seems to be used in this furnace. There would be an improvement, in addition to the other advantages, simply from cutting off the cooling effect of these tubes.

Mr. John S. Peck, of Pittsburg, read a paper on "Standard Transformer Voltages."

Mr. Moody, of Schenectady, N. Y., said that Mr. Peck's paper dealt with a subject that is extremely attractive to the transformer manufacturer. It is doubtful if many appreciate the possibilities of improvement in this direction; for instance, the General Electric Company has, in the past ten years, manufactured some 18,000 different transformers, which means five to six new designs per day. It is strange, therefore, that any attempt to reduce the demand for new ratios should be welcomed. The greatest obstacle to accomplishing any substantial results is the record that is behind us. Hundreds of plants, many of them extensive, are using transformers having ratios which should not be duplicated, but it can hardly be expected that they will be thrown away to accommodate the manufacturer. Frequently consolidation of plants into large systems covering hundreds of square miles bring into one system transmissions using altogether different ratios, new and undesirable ratios, and are needed to interconnect such systems. Again, all purchasers and consulting engineers do not as yet fully appreciate the advantages of standard ratios, which advantages they share almost equally with the manufacturers. Nothwithstanding these discouraging aspects of the situation, there is much reason to expect improvement. New plants are constantly being started which are not tied to past practice, and gradually the reconstruction of the older plants will result in changes in the desired direction, provided the manufacturer constantly keeps before the purchaser the desirability of so doing. As to the range to be covered by standard taps in large units, his experience shows ten per cent is usually sufficient; even this range means appreciably greater cost. With the fifteen per cent suggested, five per cent below and ten per cent above normal, there must evidently be ten per cent more turns and five per cent more cross-section in the transformer winding than if there was no such adjustment. Desirable as it is to minimize designs, we must not lose sight of the fact that special windings can be furnished in transformers much more readily than in other apparatus, and that the possible saving in the reduced number of designs is not great. Additional cost from adjustment ratios can easily counterbalance this saving. His experience, on the other hand, is that five per cent steps are in most cases too rough an adjustment, but ten per cent range with two-and-one-half per cent steps has proved quite satisfactory, except where the ratio must be adjusted at different loads (as when supplying lighting rotaries) in which case much smaller steps and larger range are usually necessary. Turning now to the smaller transformers for lighting, there seems to be less reason for adjustable ratios; such transformers to give satisfactory regulation at the lamp must be operated from centres of distribution with a negligible or equal drop between the centre and each transformer. It would appear that the feeder regulator rather than the transformer was the place to adjust for the variable drop in different feeders. The General Electric Company has for some time made a considerable portion of its smaller transformers with a one to nine or a one to eighteen ratio. This was not an attempt to allow for drop, but to give 110 volts or more for motors in plants having generators that would not admit of obtaining this voltage under full load. As 2,200 to 2,400-volt generators become more common, the one to ten or one to twenty ratio will answer every purpose. The speaker believes that a permanent adjustment of ratio by taps, except in the large units, operating on a line that always carries a considerable portion of its load, is to be avoided in that the adjustment can be right except for one condition of load, and is, therefore, not a real remedy for variable drop. If such a tap is used to obtain a higher secondary voltage than normal instead of to allow for drop it is still objectionable, because when in use the core loss is approximately twenty per cent higher and copper loss ten per cent less than that for which the transformer was designed. In these days when so much effort is made to obtain a transformer of the highest possible "all day" efficiency, it does not seem desirable to so greatly distort a good design as to increase the all day losses twenty per cent. Interchangeable voltages obtained by means of series multiple coupling of either primary or secondary sections are unquestionably desirable for the manufacturer and often for the purchaser as well. The extent to which it is best to carry such combinations only reaches its limit when the extra cost of so doing exceeds the saving following the reduction in the number of designs.

Mr. P. D. Wagoner, of Schenectady, N. Y., said there was one other point he wished to speak of in regard to the compensating for line losses on the smaller transformers used for ordinary commercial lighting, the use of the tap on the primary to give a higher secondary voltage, because the line drop in a long feeder ordinarily would be of service

SOME OF THE ATTENDANTS AT THE CONVENTION OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION, CHICAGO, ILL., MAY 26, 27 AND 28.

during the full load portion of the day. This is three or four hours of the day. During the other twenty or twenty-one hours of the day we would obtain a voltage much above that which is desirable for any lamp which might be turned on, and during that same period it would make the core losses eighteen to twenty per cent higher for the same reason.

Mr. C. C. Gartland, of Sioux City, Iowa, thought that at the end of the line in taking advantage of the booster, that after the consumption of the line is lowered, the higher voltage would be a detriment to the line. It appears to be a question whether it would be practicable to adopt the tap.

Mr. Wagoner said that in endeavoring to cover the higher voltage for a few hours of the day, for twenty hours of the day it would reduce the life materially of any lamp which may be connected.

Mr. Lieb thought that Mr. Wagoner's remarks and those of the gentleman who followed him did not affect the desirability of having three or four or more taps on such transformers as are used to reduce the primary voltage for rotary-current transformers. In those cases it is extremely desirable where the feeders are of such very variable length as they are, to cover large distributing territory, to have at least four or more such taps.

Mr. C. F. Hewitt agreed with Mr. Lieb's statement. He had found the second tap of very great value in long lines on which he fed motors in a combined lighting and motor load, in assisting in obtaining a fairly constant voltage on the lighting end of his system; and on the end of a long feeder carrying a motor load, on which the load is constant, he found the tap is valuable as it eliminates the necessity of adding more copper to the line, for the carrying of the load over a long period of time. In other words, it is found that in certain cases it does not pay to add additional copper to obtain the same voltage at the end of a long motor line as at intermediate points, and the additional tap comes in conveniently when the load is constant, and it does not make any difference when the motor is not used whether the voltage is higher or not.

Mr. W. G. Carlton, Chicago, stated that the Chicago Edison company has feeders varying in length from one to five miles, and did not see how it could operate without the different taps on the transformers, as long as it operates on a common bus as it does. In the air-cooled transformers it has had a little trouble, due probably to the method in which the taps were taken, which makes an additional source of trouble; but there is little trouble of that kind. Two transformers were lost from that reason. It is found necessary to have these taps to get the different voltages and take care of the regulation of the rotaries, otherwise it would be necessary to have excessive regulator capacity on the rotaries.

"The Application of Four-Ampere Series Arc Lamps for Street Lighting" was read by Mr. J. Henry Hallberg, of New York.

He sketched briefly the development of arc lighting, showing how the early system made use of high candle-power units which were found not to give satisfactory street lighting. The old ten-ampere lamp was followed by the six-ampere or half-arc, which gave more satisfactory service. The first instance of the use of these lamps for street lighting was in New York city, in 1893. The author then described the system now in use in the city of Cincinnati, where four-ampere alternating-current arc lamps are arranged on alternate sides of the street and not further than 133 feet apart. The entire system operates on a three-phase, 4,500 volt, sixty-cycle generator. The commercial efficiency of the system is over ninety-one per cent. The carbons are ten inches long and one-half inch in diameter and last 115 hours. The inner globe is opened at the base. There are 4,500 lamps in use, and these are cared for by eight trimmers working on special tower wagons. The author's experience with this plan shows that the open-base inner globe is more economical than the closed-base globe. A small reflector immediately above the arc is beneficial, but a large metal reflector for the lamp is not necessary. Notwithstanding the large size of the carbons, regulation of the system is satisfactory, and on an average less than one-quarter of one per cent of the lamps is out.

Mr. W. D'A. Ryan said there was no question but that the four-ampere lamp as compared with the six-ampere lamp has advantages in distribution; that is to say, the greater distribution of the small unit more than compensates for the higher efficiency of the large unit, so that there is considerable gain in effective illumination on the street by the use of the small unit in places where plants are not limited by the enforced distance between the lamps, such as cross streets; and in many cases they would have to place the lamps independently of the wishes of the community. Where that consideration can be neglected the small unit has an advantage, although in his opinion further advantage would be gained by the use of a three-eighths inch carbon in place of a one-half inch carbon. With a one-half inch carbon, with the arc on one side, the light is practically three times as strong on that side as on the opposite side, and the light on the arc side is out of balance to the violet. By use of the small carbon this is reduced to a considerable extent.

Mr. P. E. Bertrand asked Mr. Hallberg how the outages are figured.

Mr. Hallberg stated that no lamp is allowed to remain out more than two hours. If a lamp is defective it is removed, as a general rule, inside of two hours and a new one put in its place. The Cincinnati Gas and Electric Company never has a lamp out more than two hours, because the system is such that the men can get at the lamp after the police report it, and it is a rare case where such lamps are not reported. Most of the outs that he spoke of are due to lamps refusing to pick up, or the carbon clamps failing to work; for instance, if the lower and upper carbons are not properly clamped, not properly inserted perhaps, the resistance of the carbon circuit will be too high and consequently the lamp will not pick up, or possibly there will be a broken globe or something of that kind.

Mr. Bertrand explained his question—the number of lamps out multiplied by the time they are out is taken as the dividend, and the divisor the number of lamps burned multiplied by the total number of lamps burned by the company.

Mr. Hallberg said that he based the percentage on lamps installed. Suppose you get 100 lamps out, out of 1,000 lamps, that is ten per cent. We have about 4,500 lamps in operation, and these are about the average figures which he had given. That means we have between twenty-five and forty trouble calls in a night in an installation of 4,500 lamps.

Mr. Bertrand asked what was the relative illumination from a four-ampere and from a 6.6-ampere lamp?

Mr. Hallberg said that this was a more difficult question to answer. He ventured to say that the four-ampere lamp will hold its own. The amount of energy consumed makes no difference, and if it were not for the large investment in poles, lamps and fixtures, and the regulating devices, he believed the four-ampere lamps would in all cases prove satisfactory, if they were placed close enough together. That is a question difficult to answer, as opinions differ widely on the subject.

Mr. H. C. Wirt had given considerable thought to the question of low-voltage series lamps, and it seemed to him the question is unsettled, that is, the relative light efficiency. When the standard currents were adopted the field was open to any manufacturer to adopt these currents, and it seemed to the people he is connected with that the 6.6-ampere system was about as low a street lighting system as could possibly be used. It was thought there might be a field for something higher, and a 7.5-ampere lamp was adopted. With a four-ampere system, that means less current through the arc, and he would like to know approximately what the current through the arc is. In his consideration he had thought when he had 4.4 amperes in the street he would get four amperes in the arc, approximately. He would like to know from the central station standpoint if the system is more economical or if the four-ampere system was adopted by permission of the city fathers; it would seem to him that if the return or revenue from so many kilowatts capacity output from the station is no greater with four-ampere arc, it would be an advantage to the central station to have a less number of lamps to take care of. It is a fine question of economy. If you get a small light unit, the cost of maintaining it is greater. The cost of wiring is an important factor. Assuming sixty lamps are run in one circuit—and he considered that the limit to be used in street lighting—that gives

5,000 volts. The limit of another system is fifty lamps to the circuit. There is one objection to the enclosed system, that is, the volts per lamp are greater, seventy-five volts per lamp, whereas with the open arc it is forty-five volts, and the wiring is nearly duplicated in the street with the use of seventy-five volts. To increase the circuit by using the four-ampere lamp would be to give twice as many lamps at the same cost. He did not see where the economy comes in to the central station man.

Replying to a question from Mr. Moody as to the cost of distributing light in Cincinnati with 4,000 four-ampere lamps, Mr. Hallberg said: "The higher the arc—it is necessary in the first place to locate the lamp a considerable height above the street. If you do not, you do not get the benefit of the horizontal rays or side light. Therefore, with a high-amperage lamp you sacrifice a considerable amount of light, due to the fact it is not placed high enough to get the full effect of the light. When you get down to the low energy method of illumination, you find by placing the lamps closer together you get more of a moonlight effect. The candle-power of the lamps is comparatively low, and the light is mellow and soft, so that, although the lamp hangs low, it does not seem to affect your optical nerves in any way, and when you get past the lamp, after having its rays in your face, you do not have any bad effects from the light. You can compare it favorably with incandescent lamps. If you should place incandescent lamps in a straight row, you would have an ideal method of illumination. Of course their use is not practicable, for other reasons. The ideal illumination, in my opinion, is an illumination which is as uniform as possible, obstructs the optical nerve as little as possible, and throws as small contrasts or shadows as possible."

Another paper, not exactly on this subject, but kindred to it, on the topic "Notes on Enclosed Arc Lamps," was read by Mr. W. D'A. Ryan.

WEDNESDAY MORNING SESSION.

The meeting was called to order at 10.15 A. M. The committee on nominations was announced as follows: Samuel Insull, Chicago; James I. Ayer, Boston; Charles R. Huntley, Buffalo.

Secretary Davis announced the appointment of the committee on the president's address as follows: H. L. Doherty, Madison, Wis.; C. L. Edgar, Boston, and H. H. Fairbanks, Worcester, Mass.

Mr. Charles F. Scott, president of the American Institute of Electrical Engineers, read a paper entitled "The Young Engineer in the Electric Lighting Plant."

Within the past dozen years, power stations using a great variety of machinery have sprung up, the proper care of which requires special training. While trained mechanics may be able to keep the machinery running, they are not capable of making improvements. A central station property should have good technical supervision and direction, and there is a false tendency to economize, which rates brains too cheaply, and fails to recognize and to advance the intelligent young man. The qualifications for a central station engineer are not simple. He must not only have the technical training, but must have had practical training as well. He needs to know not only what his station is doing, but what his station can do. While a duly technical training is of great value, the essential thing is the man himself, his ability and his power of development. He must have tact and a large measure of horse-sense. The central station has taken an important place in modern affairs and the rate of development and expansion promises to continue. Questions of efficiency and economy are assuming new importance, and in connection with station management there are demands for ability in other lines which a man with engineering instinct and ability is often well qualified to meet. Experience in a small station should qualify a man for usefulness in a larger station. The rate of development of the electrical industries is rapid, more men will be needed and it should be the endeavor of the association to do all it can to promote the development of the best apparatus, the best methods and the best men.

Opening the discussion following this paper, Mr. W. B. Jackson, of Madison, Wis., said: "I would like to say a few words in connection with the paper Mr. Scott has just read and present a phase of the engineering subject to this association, which I think is very apt at the present time. I think I can speak from the standpoint of one of the younger engineers, and fully emphasize everything that Mr. Scott has said in his paper. There is one point that struck me especially and which was brought out very beautifully in the paper, and that is the necessity of a broad knowledge on the part of the electrical engineer. As has been said by the writer of the paper, the electrical engineer can not be simply an electrical engineer; he must be an electrical engineer, he must be a mechanical engineer, at least must have all the broad principles of a mechanical engineer, and in the present day he must go one step further and have a general knowledge of hydraulics which are becoming an important factor in electrical engineering work. To come to the young engineer more particularly, the point was brought out that the young engineer must know what overalls and grease and dirt are, but I think we should go one step further and bear in mind that the young engineer who goes into the dirt with his overalls and comes out and allows that dirt to remain upon him, loses his position; he drops back into the position of a mechanic or dynamo tender or engine tender. It is the young engineer who, as has been said, can think on his feet, jump into the work, get himself dirty from head to foot and come out of the dirt as clean and fine appearing a man as though he had never been in it, or even a better appearing man, is the one who will be successful. Such a man as that any man in the station is willing to follow to the ends of the earth, and such a man as that makes a very good impression upon every man he is working for. I have never been connected with the training of young engineers, but have been intimately interested in such work, and I have been impressed and pleased with the tremendous efforts that are being made by at least some of those who are training the young engineers, in teaching the man the necessity of being a man, and a well rounded man, as well as simply being an electrician. The man who is complete, who has knowledge of electrical engineering, has knowledge of the general principles of mechanical, civil and hydraulic engineering, and has the manly qualities also, presents the difference between what we may call an electrical engineer, truly, and the man whom we will have to call an electrical mechanic. The fact that not so very many years ago a man who knew a little of engineering, a little of electrical work, made an excellent man to take charge of an electric plant, does not apply in the least at the present day, and that is a reason we should so fully appreciate this paper which has been read before us this morning."

Mr. John F. Gilchrist, of Chicago, said: "I believe that the young man who wishes to make progress in the central station business to-day should be very careful to see that he has a very broad grasp of the business, especially in the smaller companies. A man of the class which Mr. Scott describes and wishes to be developed, is likely at a very early period in his career to be in an important position in the company, as regards the purely business end, as well as the engineering end. I think, so far as I have been able to judge, the engineering schools which are preparing men to take positions in central station companies should give more prominence to the business end; contract end; accounting end; the investment end; the basis on which the companies are formed, and the proper charging of all investment costs as against operating costs, to enable them to determine what the property is doing and whether it is doing as it should. I think there is a tendency on the part of the young technically educated man to rather ignore these ends of the business, feeling that the all-absorbing part is the mechanical and the electrical end. We will grant that it is very important, and the engineering end is a class of information which can not be picked up, can not be obtained practically, but must be acquired in a technical school, whereas the business end may be picked up; but do not ignore the business end of the proposition, because that is certainly as important as the other."

Mr. James I. Ayer, upon invitation of the president, took up the discussion: "We appreciate the value of thoroughness in all the various branches of engineering as well as the electrical; but it has

been quite a conspicuous thing, I think, to most employers, that all we hoped for from our technical schools has not developed. A number of companies have had occasion to undertake to break in the young engineer and they have had many disappointments, due to the wrong idea with which the graduates have viewed the situation. They like to graduate from the school into an office, into an engineer's office, into the office end of the business rather than into the mechanical end, the really practical end. I think most of us realize that the engineer's training has only been started when he leaves college. He has had a fine preparation to fit him to be an engineer, but the practical side of the work, the actual mechanical work, coming in contact with the real things themselves, he should have four or five years of work in the mechanical part of the business, during which time he would disregard in a large measure the fact he had been trained as an engineer, and would go to work as a mechanical man to learn mechanics practically, to learn his trade, in a word, and to acquire what would prove to be the most valuable part of his education. He would then be fitted to become an engineer, and if he is a man of average ability he will show up with something more than average ability in his life's work, as compared with the engineer who goes into the office, who leaves off in the college and takes up work in an engineer's office proper. We have got to know engineering as we know our alphabet, know it without having to dig it up when a problem strikes us. The fundamentals must be at our fingers' ends. The young engineer can not be qualified to meet such conditions unless he actually handles the machinery in practical use and gets such knowledge. I believe this is an important point and should be emphasized, because it is within ten years, hardly longer, since the college has graduated electrical engineers, and in fact to any extent mechanical engineers, and the necessities of the situation are not fully realized by many. I am sure in saying this I only reiterate experience of most of the gentlemen in this audience. The young engineer does not appreciate it in that way. I have employed a dozen graduates, and have tried some for a year and some for two years, and have been unable to get results which would be satisfactory to them or satisfactory to me, and it has been a great disappointment because they started at the wrong end. They wanted to start in the office, and it is not the place."

Mr. J. W. Lieb, of New York, then spoke as follows: "I believe that the proper course to develop the electrical engineer who will at the same time be fitted to take upon himself the general duties of the management of the properties as they develop to-day, necessitates first a grounding and a development as a mechanical engineer, with the electrical features subsequently superimposed. I think that the purely electrical courses, as they are organized to-day, are apt to develop electricians and not electrical engineers, and that as a result the product of these courses are apt to find themselves, soon after graduation, called upon to handle broad mechanical engineering problems, and they are handicapped by an insufficient grounding, familiarity and experience with the mechanical engineering end of this training. I believe that the proper course to pursue for the training of the electrical engineer, to enable him to cope with the modern requirements, is to give him a thorough grounding in mechanical engineering, and that, incidentally, as a part of the curriculum, electrical work, and then superimposed upon that one year of specialization in electrical engineering work. I think that the result would be the development of a higher class of engineering ability. One of the gentlemen has referred to the desirability of broader aims on the part of the engineer. I think that is extremely important, and I think that is the direction in which the engineer is apt to be open to criticism, that he looks upon the problems which are presented to him, from time to time, from too narrow, too restricted a point of view, leaving aside the important business relations which are a necessary element. I think also that what is needed perhaps in a larger measure in the present product that is presented to the companies requiring engineering assistance, is a development of common sense. If there could be a chair of common sense established in connection with a good many of our curricula, I think they would find a large field for endeavor. Another point that Mr. Scott has touched upon is the inability of the young engineer to properly present his ideas in a clear, concise form, so as to convince his employers of the strength and cogency of the arguments which he presents; and there is nothing which so handicaps the young engineer as ill-digested, loosely, not clearly, presented reports; and it should be the aim of the young engineer to qualify himself somewhat along lines which will enable him to make a strong presentation of the problems so as to impress the employers of the cogent reasons of the faith that is in him."

Professor H. E. Clifford, of Boston, presented his views as one who has been for a number of years past connected with the training of young men for the electrical engineering profession: "I have been interested in listening to the expressions of opinion this morning on the proper training for an electrical engineer. I think it would be of the greatest advantage to those teaching in the technical schools of the country if we could, from time to time, have from you, from organizations of this character, some expression of opinion as to your needs, as to the failings, as to the deficiencies of the young men who graduate from our technical institutions, and who come to do your work. I have been looking for a great many years for such an expression of opinion, and I must say, with a good deal of regret, that it has yet to come to me. It is so easy to criticise the finished product, but what we want to know is the reason why that finished product is unsatisfactory, so that we may be able to make the correction in the making of the product itself. We want to know while we are training our engineers, what they are going to need when they go out into the world, and the only way we can discover it is for some of us to come to conventions of this sort, or for you to take up the matter and to express in formal shape your conviction as to what our technical graduates need. I have been much interested in what Mr. Lieb had to offer in regard to a sound mechanical foundation for an electrical engineer. I heartily second his opinion, and it is precisely that sound mechanical foundation which we try to give our men at the Massachusetts Institute of Technology. I appreciate what he has to say in regard to the chair of common sense, but am inclined to think that common sense, on the whole, is born, not made. It is very difficult to instil common sense into a man who does not possess it, or its essentials. You must appreciate that in any electrical engineering training, the subjects which are given are selective. In the brief four years which are devoted in most technical schools to the preparation of an electrical engineer, so far as his foundation work is concerned, there is such a vast amount of material which must be touched on, and this is ever increasing in quantity, that it becomes the province of the governing body of the institutions of learning to decide on just the things which in this brief time will best conduce to the future success of the men who graduate. It is for this reason that I say again I wish we might, in our technical schools, have some expression of opinion from time to time from the National Electric Light Association as to what they have found lacking in the graduates of the technical schools of the country to enable them to carry on their work successfully. With regard to the remarks of Mr. Ayer, I think there is a better attitude among students in regard to beginning on the mechanical rather than the office side of electrical work after graduation. I am inclined to think, so far as the students with which I am brought in contact are concerned, that it is due to the influence of the alumni in sending back to us, as they do occasionally, an account of their own experience of the things which they would like to have succeeded in in the work in the particular direction they are following. But I think you must all agree, if we could have the opinion from a body of men who are actively interested in increasing the development, increasing the development of the electrical interests of the country, as to what qualifications are expected in the students, we as teachers should be in a much better, a much sounder and a much happier position in turning out the successful technical gradute."

Professor W. L. Robb, of Hartford, Ct., said that one thing which attracted his attention was the fact that nearly all the speakers from the central station

standpoint paid a compliment to the technical schools, and they all seemed to expect perfection in the young graduate of twenty-one. This can not be expected. If a young man is taken fresh from a technical school, no more can be expected from him than the hospital does from the young graduate of a medical school. It is only after years of experience that he becomes an engineer, as only in after years does a graduate of a medical school or law school become a physician in the true sense, or a broad lawyer. He agreed with what Mr. Lieb said about specialization. He thought technical school graduates ought first of all to be engineers, and after later practical experience they can become electrical, mchanical or civil engineers. Certainly any electrical engineer should have a broad foundation, not only in mechanical principles and electrical principles, but in civil engineering. Some of the first problems he will come in contact with, in passing on the design of structures and strength of material, will be problems which apply particularly to the department of civil engineering.

Mr. W. M. Anthony, of Chicago, thought that the greatest handicap to the young men going into the central station was the attitude of the station managers. They bottle up most of their information and label the bottles "poison." Until they are willing to take the labels off the bottles and show what is in them we can not complain of the technical training which the young man receives at any technical school. They come from the schools well equipped, and if they are not given a chance to display their ability, it is not their fault. The college people give them a better chance than the station managers do after the students graduate. The manager's office, the superintendent's office, and everything about the plant should be wide open to the employés of the plant along the lines of giving them necessary information regarding its workings. Take the bookkeeper in and give him some knowledge of the dynamo. The auditor's office should be open to the electrical engineer and he should be taken into its confidence, and he will get an idea of the commercial value of the dollar. The point he wished to make was: that the station managers themselves take an attitude toward the young men that is more of a handicap to the young engineer than all the colleges put together.

Professor W. E. Goldsborough, of Lafayette, Ind., said: " I have been interested in what has been said about the young engineers. As I come in contact with them a great deal, I do not like to let pass the opportunity of presenting a few thoughts which have been brought home to me strongly. Professor Robb has said that engineers should be broad engineers. I think no one will agree with him more thoroughly than I. At Purdue University I made a strong fight to have retained in the electrical course all of the civil and mechanical problems possible; but unless a sentiment develops in this country which will give us about two more years in which to educate young men, it will be impossible for us to make them broad engineers, and give them the amount of special training that they will need to meet the demand which will be made on the engineering profession. I say this condition will exist, where these trained experts will be required more and more, and it is almost upon us now. The telephone industry is going through the process; they are beginning strongly to feel the need of able technical minds in handling their business and developing economies. I was told of a station which is going to have a 100 per cent load factor and get ninety per cent out of the coal used. No man can go out and try to do that who is not technicallv educated. He must be able to see theoretically much further than the practical demands of every-day life require. The man who can see the ultimate way, the real way, the exact way of doing the thing, can afford to take short cuts. If I know the accurate way of doing a thing I can take a short cut, using good judgment. If I do not know the right way in which to do things, and then resort to makeshifts, I am weakening my position and am apt to fall into errors which will prove detrimental to the undertaking I am engaged in. It is impossible for any man at the present time to round up and fully digest all the knowledge pertaining to civil, mechanical and electrical engineering in four years. It is perfectly impossible for any man to do it. In my judgment the young engineer of the future will have four years of general engineering training along all lines, and then he should have two years of specialized training."

The next paper was read by Mr. John W. Ferguson, of Chicago, entitled "Tactful Relations with Customers."

This subject is an important one, as it strikes directly at the income of the central station company. The success of a lighting company depends upon the popularity, or lack of it, of every one connected with the company. The perfunctory performance of duties never produces preferment. It should be the aim of every one connected with the company to maintain friendly relations with customers. A solicitor should be chosen to represent in the true sense the affairs of the company. Finesse and diplomacy are qualities every solicitor should cultivate, but never at the expense of good faith. In the long run, it is sincerity that wins the business and holds it. A customer ignored is a customer antagonized. Whatever the consumer needs, the company should give him, what he thinks he needs should be found for him, what he has no way of knowing he needs should be shown to him, for the commercial development of the city and the financial advancement of the company.

The discussion following this paper was extended and interesting. Mr. Leon H. Scherch, of New Orleans, La., told of a peculiar condition of embittered relations with a customer through an inadvertant remark of a telephone boy in the employ of his company, and emphasized the need of great care in dealing with patrons. Mr. J. F. Gilchrist, of Chicago, thought that too often while the men at the head of companies realized the importance of tactful relations with consumers, they know but little of the detail of handling them. Mr. Arthur Williams, of New York, said it was gratifying to see that electrical men all over the country were giving more attention to the question of "commercial engineering." The discussion of this paper was also participated in by Mr. C. S. Rogers, of Youngstown, Ohio; Mr. Wm. M. Anthony, of Chicago; Mr. C. L. Wakefield, of Dallas, Tex.; Mr. G. W. Brine, of Atlanta, Ga.; Mr. E. F. Phillips, of Detroit, Wis., and Mr. C. M. Lewis, of Bellevue, Ohio.

The next paper, on the "Attitude of Employer Toward Benevolent Insurance and Educational Associations Among Employés," was read by Mr. Arthur Williams, of New York.

Mr. H. C. Wirt asked Mr. Williams if in the investigation of this subject he had found any opposition on the part of the employés to the societies. A friend of his devoted some attention to this subject and in several cases he found that the employés made the statement they would prefer to have the additional salary, and would prefer to make their own savings to provide for old age. In Germany employers are compelled by law to make provision of this kind. He would like to know if Mr. Williams looked into that situation.

Mr. Williams had not found that there is any objection on the part of the men to the additional payments made to these societies, because they are entirely voluntary and they get a great deal more than they take. He knew of no company which required any employé to join a benefit organization, unless it was his desire to do so. The organizations are composed entirely of the employés and are in some cases assisted by the executive management of the corporations. In every case that he had come across, joining the organization was entirely voluntary with the employé. Pensions, however, are administered entirely by the employers and are given to each employé whether he belongs to the benefit organization or not. There is no necessary relation between the sick and insurance benefit organization and the pension system.

President Ferguson read by title a paper prepared by Mr. W. D'A. Ryan, entitled "Light and Illuminating Engineering." This paper was not on the programme, but owing to the large number of papers and the time it would take to present the paper in full it was not possible to have it read.

The meeting then adjoined until 2 P. M.

WEDNESDAY AFTERNOON SESSION.

President Ferguson called the meeting to order at 2.10 P. M., and announced the first paper of the afternoon session to be "First Aid Appliances," by Dr. J. D. McGowan.

This paper gave some sensible instructions for the assistance which might be rendered to an injured person before the arrival of a physician. A box was shown which contained most of the necessary articles and appliances, and methods of treating different injuries were explained. In case of electric shock the patient should be placed in a quiet place, wrapped in warm material and heat applied to the entire body. Where respiration has ceased artificial respiration should be kept up for hours before giving the case up.

A great deal of interest was manifested in the discussion of this subject. Mr. J. W. Lieb, Jr., presented a communication which was incorporated in the minutes of the meeting. Mr. H. J. Gille said it would be a wise plan for the association to consider the matter of publishing the paper for distribution to the employés of all the companies represented. Upon motion this proposal was carried. Dr. McGowan answered several enquiries as to the nature of losses and the emergency treatment of special cases, and suggested that if it was insisted that employés handling dangerous apparatus wear rubber gloves much trouble could be avoided.

The next paper taken up was by Professor William Lispenard Robb, of the Rensselaer Institute, N. Y., on "Steam Turbines."

In opening the discussion on this paper the president called upon Mr. W. L. R. Emmet, of Schenectady, N. Y.

During his remarks, Mr. Emmet said: "Turbines may be made in any number of steps; that is, the total work of the steam may be divided into any number of elements, each fraction of the total work being used to impart velocity to the steam once. That is, we can use the whole power and discharge 4,000 feet a second, or use half power and discharge 2,700 feet per second, or quarter power and discharge 1,900 feet per second, or one-sixth power and discharge at some lower speed. Each number of discharges is a stage and separate set of nozzles, and allow the steam to be used over again, all the losses being collected and put into the nozzle, all the leakages of waste heat being all combined again and put in the nozzles and blown against a new set of line of buckets." Referring to the question of superheat, he said: "The effect of superheating in steam turbines is different with different turbines. If it is allowed to blow out of a nozzle without doing work it superheats itself, to a certain degree; that is, the power in the steam first takes the form of motion, and then comes to rest by impact with the air, and the difference of energy between the pressure of exhaust and the initial pressure takes the form of heat, and that energy superheats the steam. Consequently, in a turbine, if the turbine is inefficient, and it has little or no work, the steam from the exhaust has all its residual energy in it, which will take the form of superheat. If the turbine were ideally efficient, of a perfect theoretical efficiency, there would be a large amount of moisture in the steam, even if the steam were dry when it entered. The reason is as follows: Steam in expanding in a steam engine does not follow, simply, the adiabatic law. It attempts to follow the law, but as the temperature falls to a point at which water vaporizes at the given pressure, the water is condensed and released, and the latent heat in the water released goes into steam as expansive force and maintains the temperature of the steam, and the temperature of steam as it expands falls by a different curve from that which air would fall by, so that a large proportion of the work done by steam in expansion in engines or turbines is done by virtue of the latent air in the portion of water liquefied in the process."

The discussion on the turbine was postponed until the next session of the convention, and the convention adjourned at 4 P. M. until Thursday morning, in order to give the delegates an opportunity to visit the new station of the Chicago Edison company, and to inspect the turbine about to be installed in that station.

THURSDAY MORNING SESSION.

President Ferguson called the meeting to order at 10.15 A. M.

The first paper, on "District Steam Heating," was read by Mr. John W. Glidden, of DeKalb, Ill.

The report stated that there are about 100 heating plants in the United States using this system. About ten of these are live steam heating plants, about two-thirds of the remainder use exhausted steam and one-third hot water. Enquiries were sent out to these plants asking for information, but the returns were meagre. Some of the heating companies reported considerable revenue, but the greater number did not seem to know what they were doing. The committee suggested that a permanent committee be appointed to work continuously at the heating business, as this would be the only way in which reliable information could be obtained.

Mr. C. R. Maunsell, of Topeka, Kan., said there was no doubt whatever that there is a manifest demand for the steam business. In his town the demand greatly exceeds the capacity of the company. They have had very nice returns from it in a financial way, not only from the heating business, but in the results of the lighting and power business.

After considerable discussion a motion was carried to appoint and provide for, financially, a permanent committee to secure data on this subject.

Further discussion on the steam turbine was then taken up by Mr. J. W. Glidden, Mr. Maunsell, Mr. J. C. Gillette, Mr. Harold Alwert, Mr. Edwin Yawger, Mr. George S. Carson, Professor H. E. Clifford, Mr. H. J. Gille, and Mr. M. W. Hanks.

The next paper was read by Mr. Alexander Dow, of Detroit, Mich., on "Salt as a By-Product."

In this paper the author calls attention to many deposits of salt throughout the country and suggested that the exhaust steam in electric lighting plants might be used to evaporate brine. Some of the problems connected with this work were discussed in the paper.

As this paper was rather novel in its nature there was no discussion, and the next paper, by Professor H. E. Clifford, of the Massachusetts Institute of Technology, on "Some Fundamentals in Photometry," was taken up.

Professor Clifford spoke for the placing of photometry on an absolutely scientific basis. He cited experiments with a number of photometers and said that of the Bunsen, Kruss-Bunsen, Lummer-Brodhun, and the Joly, the Bunsen gave the best service in the hands of the student. He took up the question of the Nernst lamp as a standard, and also described an experiment with Nernst lamps and blue and yellow discs on the Purcinge effect, and its bearing on the rating of lamps.

President Ferguson called upon Professor C. P. Matthews for his report on the "Investigation of Photometric Values of Arc Lamps."

The committee decided to take up something besides arc light work this year, and attention has been given to the Nernst lamp, Welsbach mantle burner, and open gas flame.

Professor Matthews exhibited the integrating wattmeter invented by him, explaining its operation.

Mr. Arthur Williams, of New York, read the next paper, which was entitled "Decorative and Sign Lighting."

These three papers were discussed by Professor W. E. Goldsborough, Mr. M. W. Hanks, Mr. R. W. Rollins, Mr. W. D'A. Ryan, Mr. Arthur Williams, Professor Matthews, Professor Clifford, and Professor D. C. Jackson.

The meeting adjourned until 2.15 P. M.

THURSDAY AFTERNOON SESSION.

The first paper was read by Mr. William Cooper, of Cincinnati, Ohio, on "Relative Advantages of Electrical and Mechanical Methods of Variable Speed Control for General Power Service." This paper was discussed at length by Mr. A. W. Lloyd, of Chicago; Mr. H. M. Lyman, who presented a communication on the subject; Mr. H. J. Gille, Mr. Arthur Williams, Mr. J. W. Lieb, Jr., Mr. F. W. Bowen, Professor Morgan Brooks, Mr. C. W. Coiner, Mr. H. T. Hartman, Mr. Frederick J. Pearson, Mr. F. E. Smith, Mr. Harold Alwert and Mr. Cooper.

The next order of business was the reading of the report by Mr. Robert L. Elliot, of Chicago, on "The Theft of Current."

With the rapid growth of electric lighting companies and the consequent ever-increasing network of wires emanating from them, there are opportunities for obtaining current fraudulently. Methods adopted by the offenders are: tapping the wires before they reach the meter, introducing various articles into the meter-case or tampering with the connections in such a way as to make the meter indicate falsely. Constant and careful inspection by employés is necessary to detect theft, and in all cases where the inspector dis-

covers any suspicious conditions he should report the matter to the office without changing them in the least. Where the connections are tampered with, a recording voltmeter will often show at what time of the day this is done, and thus lead to detection. Where the meter is interfered with, a separate meter should be placed on the same circuit and in such a position as not to excite suspicion. Suggestions were made for points which should be covered by a satisfactory law against this crime and a number of precautions were given for preventing interference with the meter.

Several speakers joined in the discussion of this paper, detailing methods of theft and means for avoiding a continuance of loss from this source, including Mr. P. H. Bartlett and Mr. J. F. Gilchrist, and several points with regard to the law in this case were raised.

Mr. L. G. Van Ness, not being present, his report on "Unaccounted-for Current" was postponed, and Mr. H. T. Hartman, editor of the "Question Box," was introduced, and read the introductory.

Mr. Hartman took the chair and called for the report on the president's address, which was presented by Mr. Brady, as follows:

"National Electric Light Association, Gentlemen—The committee to which the excellent introductory address of your president was referred for report on the suggestions contained therein beg to make the following recommendations:

"(1) That a committee of three engineers be appointed by the president to report to the next annual meeting on the development of the steam turbine, and this committee further recommend that said committee be authorized to expend a sum not to exceed $1,000 in the investigation of the subject.

"(2) We further recommend that a committee of three members be appointed by the president in accordance with the following recommendation contained in the president's address: 'I would recommend to you, therefore, the appointment of a small committee of forceful men to watch the movements of other kindred bodies and engineering societies, to confer with them from time to time and to promote a closer relationship with them, so that their actions may not be antagonistic to the members of this association.'

"(3) That a committee of three from various portions of the country be appointed to collect information and report to the association at its next meeting.

"The committee further wish to urge the continuation of a Progress Editor, and other reports on special subjects; also the continuation of the Question Box in its present form, which seems to fill all requirements and to result in a saving of time as against the former method.

"In conclusion, the opinion of the committee, to which the president's address was referred, is that the address is of such general interest that it should be printed and distributed to the members of the association in pamphlet form. This, therefore, your committee would recommend."

On motion the report of the committee was adopted and the special recommendations of the report were authorized.

The meeting then adjourned to executive session.

In the executive session an amendment to the constitution and by-laws was adopted, making the dues of associate members $20. This simply corrected an oversight in omitting the dues of associate members from the amendment adopted at the Cincinnati convention.

The report of the Committee on Nominations was presented and the following named gentlemen were elected as officers for the ensuing year:

President, Charles L. Edgar, Boston.

First vice-president, S. B. Livermore, Winona, Minn.

Second vice-president, John W. Lieb, Jr., New York.

Members of Executive Committee for three years: Louis A. Ferguson, Chicago; H. A. Bottomley, Fall River, Mass.; Alex Dow, Detroit.

President-elect Edgar was escorted to the chair, and President Ferguson congratulated the association on its wise selection of a president, and extended his best wishes to President Edgar for a successful administration.

President Edgar replied: "Gentlemen of the National Electric Light Association, I thank you for this honor. I recognize that it is an honor to be made president of this association. It was my good fortune to be vice-president in 1890. It is impossible to describe the difference between the meeting of the association in 1890, at Cape May, and 1903 at Chicago. I recognize I have a hard row to hoe. Each president naturally desires to make his meeting somewhat better than the previous one; and I know you will all admit I will probably not make the meeting next year anywhere equal in interest and importance to that through which we have just passed. I do not know that I can say a word more to emphasize it than that the success of this meeting is due to Mr. Ferguson. We all feel it, and we hope he appreciates the fact; that we know he as president has done more to promote the interests of the National Electric Light Association than any previous president."

On motion of Mr. Scovil, a vote of thanks was passed to the retiring president, Mr. Ferguson.

Mr. Ferguson expressed his appreciation of the association's sentiment, and his thanks for the attention which had been given to the papers, and for the assistance which had been afforded him during his admistration.

President Edgar announced that a paper had been sent to the convention by Professor Elihu Thomson, on "The Development of the Electric Power Station." A paper on "A New Form of Arc Light Photometer," by R. R. Lawrence, was read by title.

The report of the treasurer was presented, and showed the following financial transactions during the year:

Receipts, including balance, 1902....	$17,091.52
Disbursements.....	8,439.55
Balance.....	$8,651.97

In connection with the report of the Committee on Standard Rules for Electrical Installation, the following resolution was passed:

Resolved, That a vote of thanks be tendered the committee for its diplomatic and effective efforts to secure a reasonable and practical set of rules;

That the association expresses its appreciation of the importance of cooperation with the National Board of Fire Underwriters in work where mutual interests are involved, and that it recognizes the value of the results obtained since there has been such cooperation;

That a set of the rules and the report of the committee be printed and sent to each active member of this association, and that action on said committee report be deferred until the next regular meeting of the association;

That any change in the personnel of the committee for the coming year be referred to the incoming president for such action as he may deem desirable.

On motion of Mr. Scovil the following resolution was passed:

Resolved, That the proper officers of this association suggest to the National Underwriters' Association that they would consider it a compliment if they can see their way clear to include the cost of their electrical inspection in their rates.

On motion, the action taken at the Cincinnati convention, fixing the place for the 1904 convention at St. Louis was reconsidered, and the matter of the time and place for the 1904 convention was left with the Executive Committee, Boston, Mass., being subsequently selected as the place for the convention of 1904.

On motion, it was voted to hold a special meeting in St. Louis in September, 1904, in conjunction with allied organizations.

Mr. J. G. White, of New York, moved that the thanks of the association be tendered to the electrical interests of Chicago, particularly the officials of the Edison company, for the information, assistance and attention they have given and rendered to the delegates to the convention, and that the secretary send a copy of this resolution to the chairman of the Entertainment Committee. (Carried.)

Adjournment.

Annual Meeting of the New York Electrical Society.

The annual meeting of the New York Electrical Society for the election of officers, will be held at the Café Boulevard, Tenth street and Second avenue, Wednesday, June 10 at 9 P. M. The meeting will be preceded at seven o'clock by a dinner.

A special meeting called to consider and discuss the amendments to the constitution and by-laws recently recommended by the executive committee June 1, was sparsely attended, fifteen only being present. The amendments, with two exceptions, were accepted, and the meeting adopted a motion to prevent the election of any officer except the secretary and the treasurer for a second immediate term.

The Convention Attendance.

EVIDENCE was not wanting to show that the electrical manufacturers and dealers in all parts of the country appreciate the value of these annual meetings under the auspices of the National Electric Light Association, inasmuch as the attendance, at this year's session, by representatives of these companies was much larger than at any preceding meeting. And, too, the number of companies in evidence through their presidents and heads of departments with staffs of men consisting of from six to thirty persons was surprisingly great. The purpose, in the minds of these companies, does not seem to be to effect sales at these gatherings, but rather to make them opportunities for observation and education and personal intercourse.

Exhibitions of apparatus were made only in a few instances, and in this matter the feeling prevails that American electrical equipments are so near to standardization that for these events well printed bulletins and journal advertising are more efficacious. Regret was expressed by those who read carefully prepared papers that the numbers present at the meetings of the convention sessions were not larger; but this does not argue any lack of appreciation for these papers, because delegates in many instances prefer to use this time for other interests, knowing that it will be possible to find these papers in early issues of the technical press, thus permitting them to read and digest them at their better leisure.

Among the thousand visitors present, some of whom did not register, the following are of especial interest as being prominent in the commercial rather than in the operative side of the electrical industry.

There were a number of little dinner and luncheon parties given during the convention. Mr. G. H. Atkin, of the Electric Storage Battery Company, gave a very highly enjoyable luncheon to a number of friends at the Chicago Yacht Club. Other events were dinners and luncheons by Mr. J. G. White, Mr. E. H. Mullin, Mr. George T. Manson, Mr. A. H. Patterson, Mr. C. O. Baker, Jr., Mr. E. F. Peck and Mr. George F. Porter. The club courtesies were quite generally used.

The Phœnix Glass Company, Pittsburg and New York, was represented by Mr. A. H. Patterson, vice-president, and Mr. T. H. Howard, of Pittsburg. Mr. Howard is the son of President Howard, of the Phœnix company, and enjoyed meeting the electric light men on the occasion of his first convention.

The Duncan Electric Manufacturing Company, La Fayette, Ind., was represented by Thomas Duncan, C. H. Norwood and the Baltimore agent C. H. Flannery.

The Electric Material Company, Baltimore, Md., was represented by C. H. Flannery.

The Stanley Electric Manufacturing Company, Pittsfield, Mass., was represented by R. D. Lillibridge, D. W. Dunn, U. W. Bergenthal, E. L. Barr, Locke Etheridge.

The Standard Underground Cable Company, Pittsburg, Pa., was represented by the following: J. R. Wiley, manager the Chicago office; E. J. Pietzcker, Chicago; W. M. Rogers, Chicago; C. J. Marsh, New York; T. E. Hughes, Philadelphia; A. A. Anderson, Pittsburg.

The Sunbeam Incandescent Lamp Company, Chicago, Ill., was represented by L. G. Bassett, W. E. Meyers.

Hart & Company, Chicago, Ill., was represented by J. S. Maurer, manager, and E. Kerns.

The Fort Wayne Electric Works, Fort Wayne, Ind., was represented by F. S. Hunting, sales manager, and A. A. Serva, assistant sales manager, and the following staff: W. S. Goll, manager the Chicago office; T. J. Ryan, manager the Cincinnati office; W. C. Knight, manager the St. Louis office; F. McMasters, manager the Chicago office; J. H. Raymond, Chicago; I. S. Jackson, Chicago, and E. A. Wagner, manager the transformer department.

The American Circular Loom Company, Chelsea, Mass., was represented by A. S. Clark, president; H. B. Kirkland, general sales manager; R. B. Corey, sales representative for Greater New York; Thos. G. Grier, sales representative at Chicago.

The Monarch Electric and Wire Company, Chicago, was represented by A. D. Gillespie, C. A. Kuhlman and H. Schwab.

The Electric Appliance Company, Chicago, Ill., was represented by the following: W. W. Low, President, and staff as follows, I. A. Bennett, J. B. McMullin, W. P. Upham, P. R. Boole, S. A. Rall, E. C. Brown. In addition, the following companies were represented in connection with the Electric Appliance Company: Jacob Bunn and R. C. Lanphier, Sangamo Electric Company, Springfield, Ill.; W. D. Packard, New York & Ohio Company, Warren, Ohio; James McBride, McBride Electric Company, Detroit, Mich.; J. G. Pomeroy, Adams-Bagnall Electric Company, Cleveland, Ohio; James McGill, Crescent Company, Chicago, Ill.

The Westinghouse Electric and Manufacturing Company was represented by the following: From Pittsburg—Frank H. Taylor, Arthur Hartwell, W. H. Whiteside, C. S. Cook, John S. Peck, F. N. Kollock, Jr., S. H. Anderson, G. B. Dusinberre, W. M. Probasco, H. P. Davis, C. F. Scott. From Chicago—T. P. Gaylord, Ervin Dryer, C. W. Regester, W. D. McDonald, Frederick Nelson, Arthur Huntington, J. J. Gibson, W. R. Pinckard, A. L. Millard, Norman Stewart, A. M. Miller, P. S. Gibson, R. E. Schaulin, E. J. Burke. From New York—E. W. T. Gray. From Syracuse— G. W. Pulver, S. B. Storer. From Seattle—M. P. Randolph, A. E. Ransom. From Boston—R. N. C. Barnes. From Detroit—R. L. Rathbone, W. C. Armstrong. From Cincinnati—H. C. Marsh. From Cleveland—N. S. Braden.

The Sawyer-Man Electric Company was represented by Frank S. Smith and T. H. Bailey Whipple, New York; C. A. Ross, Chicago, Ill.

The Banner Electric Company, Youngstown, Ohio, was represented by N. L. Norris, J. E. Hart, E. N. Beach, R. T. Hamilton and F. C. Kikchner.

The H. W. Johns-Manville Company, New York, was represented by J. W. Perry, of the New York office, manager of the electrical department; S. H. Finney, manager of the Chicago office, and H. W. Frantz.

The Standard Electrical Manufacturing Company, Niles, Ohio, was represented by James Porter Gilbert, secretary and treasurer, and John Rice, H. H. Albret, J. H. Bullock and L. Le Bourveau.

National X-Ray Reflector Company, Chicago, Ill., was represented by A. L. Moore, secretary and treasurer, and E. L. Haines, general manager.

The Valentine-Clark Company, Chicago, Ill., was represented by E. L. Clark, F. L. McGillan and J. A. Greenwood.

The Elblight Company of America, New York, was represented by Russell Spaulding, E. H. Abadie, J. A. Haines and E. M. Barter.

Jewell Electrical Instrument Company, Chicago, Ill., was represented by Edward W. Jewell, president.

Chase-Shamut Company, Boston, Mass., was represented by Harry P. Moore.

Wagner Electric Manufacturing Company, St. Louis, Mo., was represented by R. J. Russell, assistant sales manager, Chas. C. Warner and George B. Foster.

The Phelps Company, Detroit, Mich., was represented by Alex Dow, president; W. E. Phelps, vice-president; W. J. Phelps, inventor of the "Hylo" regulating lamp, and J. W. Wiley Phelps, sales manager.

The Alphaduct Manufacturing Company, New York, was represented by William B. Porter, Chicago, western sales manager.

A. P. Hopkins & Company, Escanaba, Mich., was represented by A. P. Hopkins, president, and Allan Hopkins, secretary.

National Battery Company, Buffalo, N. Y., was represented by W. W. Burke, sales manager.

Federal Electric Company, Chicago, Ill., was represented by J. W. Gilchrist.

American Carbon and Battery Company, St. Louis, Mo., was represented by Henry Wrape, president.

The National Carbon Company, Cleveland, Ohio, was represented by N. C. Cotabish, sales manager, and C. W. Wilkins, A. D. Spear, F. H. Murray, F. H. McDowell, F. C. Park, F. J. Kysela, A. V. Ward, A. G. Henry, A. C. Carrier, Wallace O'Connor and J. C. Irvine.

The American Electric Works, Providence, R. I., was represented by F. E.

Donohoe, western manager, E. H. Hammond and G. S. Seminees.

The American Push Button Telephone Company, 136 Liberty street, New York, had a very clever exhibit, consisting of two of its private line telephones connected to 200 feet of flexible cord, the whole outfit including batteries, telephones and wire contained in a small grip. This company was represented by its manager, Mr. W. U. Sweeten.

Pass & Seymour, Solvay, N. Y., was represented by B. E. Salisbury, secretary and general manager.

W. N. Matthews & Brother, St. Louis, Mo., was represented by F. A. Churchill, Jr.

The F. Bissell Company, Toledo, Ohio, was represented by M. S. Walker.

The McRoy Clay Works, Brazil, Ind., was represented by E. F. Kirkpatrick.

The Nernst Lamp Company was represented by C. W. Rice, R. H. Lee, Jr., and M. W. Hanks, Pittsburg; A. E. Fleming, G. E. Bennett and F. H. Carpenter, Chicago.

Pittsburg Sewer Pipe and Conduit Company, Pittsburg, Kan., was represented by A. R. Batley, manager.

J. W. Turner, underground engineer, Youngstown, Ohio, was present.

Crocker-Wheeler Company, Ampere, N. J., was represented by Putnam A. Bates, sales manager; C. W. Startsman, of the sales department at Ampere; Julian Roe, manager Chicago office; F. M. Holbrook and H. P. Whipple, of the Chicago office.

Carleton-Chase Electric Company, New York, was represented by J. A. Vaughan, manager of sales.

The National Electric Company, Milwaukee, Wis., successor to the Christensen Engineering Company, was represented by F. L. Hutchinson, manager of electrical sales; Charles G. Burton, manager of the Chicago office; Arthur Jones, of Chicago office; from the engineering department at Milwaukee, W. L. Waters, chief engineer, and Charles G. Knight and W. J. Richards.

The General Electric Company occupied the large reception halls on the drawing-room floor. Those present were: J. R. Lovejoy, general manager of the lighting department; B. E. Sunny, manager Chicago office; C. B. Davis, manager Boston office; A. F. Giles, manager Atlanta office; J. S. Anthony, acting manager New York office; A. D. Page, manager incandescent lamp sales; C. D. Haskins, W. S. Moody, H. W. Hillman, Schenectady; J. C. Calisch, Buffalo; H. J. Buddy, Philadelphia; G. D. Rosenthal, St. Louis; W. D'A. Ryan, Lynn; J. H. Livesy, Detroit; P. D. Wagoner and E. H. Mullin.

Crouse-Tremaine Carbon Company, Fostoria, Ohio, was represented by H. A. Tremaine, secretary and treasurer.

The Standard Chemical Company, Boston, Mass., was represented by George B. Davis.

The Bryan-Marsh Company was represented by G. C. Keech, manager the Chicago office; E. H. Haughton, manager the Cincinnati office; L. P. Sawyer, of the Chicago office; J. L. Corby, J. L. Barnard, A. G. Bowers.

The Okonite Company, New York, was represented by George T. Manson, general superintendent, and a staff from the Central Electric Company, Chicago, the company's western agents.

The Bryant Electric Company, Bridgeport, Ct., was represented by W. C. Bryant.

The Sprague Electric Company, New York, was represented by Alex. Henderson, E. W. Kittle and staff.

The Standard Vitrified Conduit Company, New York, was represented by Bleecker S. Barnard.

The Consolidated Engine-Stop Company, New York, was represented by F. S. Palmer.

Baker & Company, Newark and New York, was represented by C. O. Baker, Jr., and J. J. Lowthian.

The Stanley Instrument Company, Great Barrington, Mass., was represented by W. H. Browne, S. O. Ochs and F. J. Alderson.

The Sterling Electric Manufacturing Company, Warren, Ohio, was represented by William Coale and George L. Sayle.

The Electrical Equipment Company, Chicago, Ill., was represented by A. W. Tobin.

Simplex Electric Company, Boston, Mass., was represented by J. G. Brobeck, manager, and W. W. Tenney, of the Chicago office.

National India Rubber Company, Bristol, R. I., was represented by P. F. Lyons.

Peerless Electric Company, Warren, Ohio, was represented by H. B. Ramsey.

Consumers Carbon Company, Lancaster, Ohio, was represented by E. J. Kennedy.

Manhattan Electrical Supply Company, New York and Chicago, was represented by F. M. Pierce, of Chicago.

Fairbanks, Morse & Company was represented by William A. Moore, of Chicago; L. J. Osborne.

M. B. Austin & Company, Chicago, Ill., was represented by M. B. Austin, H. B. Mason and a large staff of men.

McIntosh, Seymour & Company, Auburn, N. Y., was represented by J. A. Seymour.

The Dale Company, New York, was represented by John Dale, president.

American Steel and Wire Company was represented by C. S. Knight, F. A. Keyes and a number of other gentlemen from the Chicago, New York and other offices; B. H. Ryder.

Norden-Bittner Company, New York, was represented by Mortimer Norden.

Pittsburg Reduction Company, Pittsburg, Pa., was represented by E. H. Noyes, manager the Chicago branch.

Yost Electric Manufacturing Company, Toledo, Ohio, was represented by J. Harry Yost, Frank H. Chapman.

Chicago Sectional Underground Covering Company, Chicago Ill., was represented by C. H. Wilmerding, president.

American Insulated Wire and Cable Company, Chicago Ill., was represented by Jno. P. Dale.

Chicago Fuse Wire Manufacturing Company, Buffalo and Chicago, was represented by W. W. Merrill.

Porter & Berg, Chicago, Ill., was represented by E. R. Mason.

The Ball & Wood Company, Elizabethport, N. J., was represented by A. D. Wyckoff.

Atlantic Insulated Wire and Cable Company, Stamford, Ct., was represented by George H. Porter, sales manager of New York.

American District Steam Company, Lockport, N. Y., was represented by J. Charles Young, manager the Chicago office, and H. C. Eddy.

The Standard Paint Company, New York and Chicago, was represented by J. C. Shainwald, manager of the Chicago office.

Economical Electric Lamp Company, New York, was represented by M. Lobenthal.

Chicago Belting Company was represented by J. H. Shay.

The Acme Switch Company, Cleveland, Ohio, was represented by Willard Fuller.

The Simplex Electrical Heating Company, Boston, Mass., was represented by James I. Ayer.

The Electric Storage Battery Company, Philadelphia, Pa., was represented by Charles Blizard, of Philadelphia, and G. H. Atkins, Chicago; H. B. Gay, Cleveland, Ohio; E. Osthoff, the company's Chicago engineer; R. H. Klander, manager of the St. Louis office, and G. H. Hill, Chicago.

The Chicago Insulated Wire Company, Chicago, Ill., was represented by William B. Smith.

The Michigan Electric Company, Detroit, Mich., was represented by Maurice W. Thomas.

J. G. White Company, New York, was represented by J. G. White.

The Diehl Manufacturing Company, Elizabethport, N. J., was represented by B. C. Kenyon, general manager.

Royal Electric Company, Peoria, Ill., was represented by G. G. Luthy.

S. B. Condit, Jr., and Company, Boston, Mass., was represented by S. B. Condit, Jr.

Doubleday-Hill Electric Company, Pittburg, Pa., was represented by Charles Phillips Hill.

Moloney Electric Company, St. Louis, Mo., was represented by T. O. Moloney, president.

Osburn Flexible Conduit Company, New York, was represented by C. E. Corregan, H. G. Osburn and Calvin B. Roulet.

The India Rubber and Gutta Percha Insulating Company, Yonkers, N. Y., was represented by James B. Olson, of New York, general sales manager.

Adams-Bagnall Electric Company, Cleveland, Ohio, was represented by J. G. Pomeroy, manager the Chicago office.

Colonial Electric Company, Ravenna, Ohio, was represented by J. B. Estabrook, assistant secretary and treasurer.

Varley Duplex Magnet Company, Phillipsdale, R. I., was represented by C. A. Hibbard, manager of the Chicago office.

Kuhlman Electric Company, Elkhart, Ind., was represented by J. A. Johnson, secretary.

Speer Carbon Company, St. Mary's, Pa., was represented by J. S. Speer, general manager.

Hemingray Glass Company, Covington, Ky., was represented by D. C. Hemingray.

Cutler-Hammer Manufacturing Company, Milwaukee, Wis., was represented by F. R. Bacon, president; H. H. Cutler, A. P. Munning.

National Cable and Conduit Company, New York, was represented by W. S. Eckert, H. F. Tate, J. B. Honan, W. H. Pearl, F. B. Swizer.

Columbia Incandescent Lamp Company, St. Louis, Mo., was represented by R. B. Corey, New York, and the manager of the Minneapolis office.

The Gould Storage Battery Company, New York, was represented by E. L. Draffan, manager of the Chicago office; Harry B. Oakman, A. S. Hubbard, Edward Lyndon.

Gregory Electric Company, Chicago, Ill., was represented by A. O. Kuhnsted, G. M. Ellis, R. H. Watson.

The John A. Roebling's Sons Company was represented by H. C. Gieffell, George C. Bailey, A. B. Conover, Jr., William H. Singluff and H. C. Griffen, Jno. T. W. Montgomery, Chicago; F. W. Harrington, New York; D. F. Ivins, Trenton, N. J.

The Fostoria Incandescent Lamp Company, Fostoria, Ohio, was represented by J. B. Crouse, B. G. Tremaine, J. Robert Crouse, H. H. Geary, general sales manager; C. K. Wells, and F. G. Kratzer.

The Crouse-Hinds Electric Company, Syracuse, N. Y., was represented by Mr. Crouse and F. M. Hawkins, manager of the New York office; F. F. Skeel, manager of the Chicago office.

C. R. Pierce, Chicago, Ill., a manufacturer of electric light line construction tools, was present.

General Incandescent Arc Light Company, New York, was represented by J. Henry Hallberg.

The Bullock Electric Manufacturing Company, Cincinnati, Ohio, was represented by F. G. Bolles, assistant manager of sales; George B. Foster, manager of the Chicago office, and L. B. Hoit. The Bullock company established a registering system in connection with the official books, and issued numbered buttons to all visitors. In addition, a daily bulletin was printed and circulated, free of cost, with the name and number of each individual with the location of each visitor's lodgings. This was a perfect and instantaneous means of identification. The system was excellently carried out and won the praise of all who were present.

The Triumph Electric Company, Cincinnati, Ohio, was represented by W. H. Jacob.

Reynolds Electric Flasher Company, Chicago, Ill., was represented by C. F. Ziegler, manager.

Kohler Brothers, Chicago, Ill., was represented by C. K. Kreider.

McGuire Manufacturing Company, Chicago, Ill., was represented by W. J. Cooke.

R. B. Corey, New York sales manager for Columbia Incandescent Lamp Company, American Circular Loom Company, Bossert Electric Manufacturing Company, and Hart & Hegeman Manufacturing Company.

Buckeye Electric Company, Cleveland, Ohio, was represented by M. K. Eyre, president, and J. H. Cooke, manager Chicago office.

Ewing-Merkel Electric Company, St. Louis, Mo., was represented by N. Ewing, president, and Milton Mills, secretary.

American Conduit Company, Los Angeles, Cal., was represented by W. S. McCarthy, manager Chicago office.

Lindsley Brothers & Company, Menominee, Mich., was represented by George L. Lindsley, president, and J. Alexander Navarre, assistant business manager.

Fowler-Jacobs Company, Chicago, Ill., was represented by John H. Fowler.

Mechanical Boiler Cleaner Company, Chicago, Ill., was represented by W. H. Mason, manager western interests.

Dickey-Sutton Carbon Company, Lancaster, Ohio, was represented by Edmund Dickey, general manager.

H. T. Paiste Company, Chicago and Philadelphia, was represented by E. A. Jenkins, manager Chicago office.

Jandus Electric Company, Cleveland, Ohio, was represented by J. H. Cooke, manager Chicago office.

Eugene Munsell & Company, New York and Chicago, was represented by Charles E. Coleman, manager Chicago office.

G. M. Gest, New York and Chicago, was represented by F. C. Mott, manager New York office, and W. T. Jackson, of the Cincinnati office.

Dearborn Drug and Chemical Company, Chicago, Ill., was represented by W. H. Edgar, president, and R. F. Carr.

Chicago Insulated Wire Company, Chicago, Ill., was represented by W. M. Smith.

New York Insulated Wire Company, New York, was represented by James Wolff, manager Chicago office. Mr. Wolff was active on the Entertainment Committee.

Crescent Company, Chicago, Ill., was represented by J. H. McGill.

Sunbeam Incandescent Lamp Company, Chicago and New York, was represented by F. S. Terry.

Western Electric Company, Chicago, Ill., was represented by C. D. Crandall, A. L. Tucker, E. M. Scribner, E. W. Rockefeller, P. T. Ackerman, F. K. Kretschmar, M. L. Scobey, C. W. Cobb, manager Cleveland office, E. R. Field, L. J. Milnor, W. L. Stockton, W. S. Hine, L. G. Bassett, and others.

Warren Electric Manufacturing Company, Sandusky, Ohio, was represented by A. N. Searls, manager Chicago office.

Dayton Electrical Manufacturing Company, Dayton, Ohio, was represented by B. G. Apple, president.

Rossiter, MacGovern & Company, New York, was represented by Frank MacGovern and J. A. Pierce, manager St. Louis office, and George Cutter.

Marine Engine and Machine Company, New York, was represented by C. A. Benton.

Ridgway Dynamo and Engine Company, Ridgway, Pa., was represented by Wm. Sharpe, Chicago office.

Browning Manufacturing Company was represented by A. Lester Thayer, manager Chicago office.

C. & C. Electric Company, Garwood, N. J., was represented by E. Sanderson, manager Chicago office.

Philadelphia Electric Company, Philadelphia, Pa., was represented by A. J. De Camp.

Woodward Governor Company, Rockwood, Ill., was represented by E. E. Woodward.

A. L. Ide & Sons, Springfield, Ill., was represented by Enos Bookwalter, manager Chicago office.

Holophane Glass Company, New York, was represented by V. R. Lansing Company, of Chicago. Both Van Renssalaer Lansing and H. M. Lauritzen were present.

H. B. Camp Company, Chicago, was represented by J. A. Hammett, sales agent, Chicago.

American Vitrified Conduit Company, New York, was represented by Stephen Douglass.

Washington Carbon Company, Pittsburg, Pa., was represented by J. S. Crider.

Western Electrical Supply Company, St. Louis, Mo., was represented by R. S. Wakefield and L. F. Philo.

Green Fuel Economizer Company, Matteawan, N. Y., was represented by W. J. Best, manager Chicago office.

The Fuller Company, Detroit, Mich., was represented by R. Fuller.

Gregory Electric Company was represented by E. A. Cassin.

New York Safety Steam Power Company, New York, was represented by Milton Thomas, manager Chicago office.

Northern Electrical Manufacturing Company, Madison, Wis., was represented by F. L. Stagg and Herbert Markel, of the Chicago office.

Ohio Elevator Company, Yonkers, N. Y., was represented by John D. Sheldon.

Central Electric Company, Chicago, Ill., was represented by George A. McKinlock, president, and a large staff from its sales department was present.

Milwaukee Electric Company, Milwaukee, Wis., was represented by Walter Cary, vice-president, Thomas H. Rodman, manager Chicago office, and several gentlemen from the engineering department.

A. M. Barron, consulting engineer, South Bend, Ind., was present.

Illinois Electric Company, Chicago, Ill., was represented by Frank E. Healy, president; L. K. Cushing, secretary; Carl Keith, treasurer, and D. Newman.

Benjamin Electric Manufacturing Company, Chicago, Ill., was represented by President Benjamin.

NOTES ON X-LIGHT.

BY DR. WILLIAM ROLLINS.

NOTE CLVII—ON THE MEANS OF ATTACHING THE TERMINALS OF THE X-LIGHT TUBE TO THE ELECTRIC GENERATOR.

At first all X-light tubes were provided with platinum loops at the ends for the attachment of the wires from the generator, which were hooked into them. Finding that an accidental pull on the wire, which is quite likely to happen in the darkened room in which all fluoroscopic examinations are made, cracked the tube about the wires, thus spoiling it until repumped, I abandoned loops, devising a spiral spring contact, the terminals of the tube being straight projections (note iv, December 15, 1897, and note cxxxviii). The spiral spring arrangement was illustrated in note cxxxix. A better form, because easier to operate in a darkened room, is shown here. In note xxxvi, Fig. 4, I showed a non-radiable tube-box with sliding arms, which I had used since 1896 to prevent any X-light from escaping into the room except what was required. It is to a box of this kind, indicated by the letters TB, Figs. 1 and 2, that the sliding arm A supporting the contact-post CP is attached, that the contact-disc D may be brought against the terminal of either a long or a short X-light tube. The arm is clamped in any position by the milled head MH. The contact-disc D is attached to the end of a steel rod R, around which is a spiral spring of piano wire SP, which always keeps the contact-disc pressed against the terminal wire of the X-light tube T. The contact-post is insulated by the hard rubber collar and sleeve HR. The length of the contact-post can be varied. It is held in any position by the screw S. Another similar screw clamps the wire W from the electric generator to the contact-post. The means of attachment shown in Figs. 1 and 2 is the safest and most rapid I have used. However hard an accidental pull is given to the wires from the generator, no strain is brought upon the X-light tube, and, moreover, as there is always contact between the terminals of the tube and the electric generator, there is no spark-gap where they join and consequently no heat from this source to crack the tube around the terminal wire.

NOTE CLVIII ON METAL TUBES BETWEEN THE X-LIGHT TUBE AND THE PATIENT FOR IMPROVING THE DEFINITION OF THE PHOTOGRAPH.

In 1886 Leeds and Stokes published photographs showing that a diaphragm improved the sharpness of an X-light photograph. In August of that year I printed in the *International Dental Journal* a description and illustration of an improvement which made a diaphragm of more use in medicine, publishing the use of a diaphragm as original, not knowing of the observations of Leeds and Stokes. My diaphragm was not fixed, but could be quickly made concentric with the central ray of X-light used to take the photograph. This was important, for, as stated in former notes, the central ray should always strike the plate normal to its surface. Later I showed that no X-light should be allowed to strike the

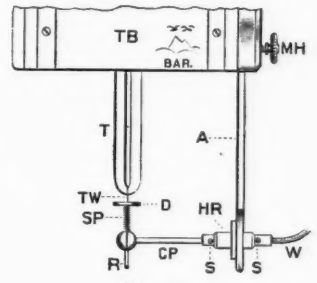


FIG. 1.

patient except enough direct X-light to cover the area to be examined, treated or photographed, describing and illustrating a tube-box which made the procedure practical. I also showed (note x, January 5, 1898) that the light should be of such wave-length as suffered least diffusion in the tissues, proving that scattered light which resulted from using X-light of improper wave-length prevented sharp images, because it suffered unnecessary diffusion in the tissues. This note and note vi, December 22, 1897, on the same subject were important contributions to X-light literature, though their value is not yet clearly recognized. The other reason given for preventing the escape of all unnecessary X-light was this—as X-light spreads as a spherical wave, filling a room with an actinic mist which radiates X-light in every direction, penetrating through the back of the plate with sufficient force to make images of objects on the opposite side from the source of light (see Fewkes's report), it was essential to prevent the escape of every ray not needed to make the photograph or to illuminate the screen. Several physicians have since described some of my results as original with themselves. One case occurs in a recent German work, brought to my attention to-day by a friend who partly translated it to me. In this book are many illustrations of the author's methods of improving the definition of the image on the photographic plate. In America physicians look to Germany for guidance. Any German medical apparatus will receive attention though earlier and better apparatus of American design had previously been ignored. Therefore I point out some errors of the author. Instead of covering the patient with a non-radiable sheet to exclude all diffused X-light, as I have recommended, placing the tube in my non-radiable box from which no X-light can escape except the smallest beam that will cover the required area to be examined, treated or photographed, the tube-box being mounted on an independent support that the patient may easily be moved into proper relation to the source of X-light; the author attaches the tube to the examination table on which the patient is lying. Between the X-light tube and the patient he places a metal cylinder extending to the body of the patient. The sides and back of the X-light tube are open for the escape of X-light, thus allowing the room to be filled with the actinic mist with the consequences already mentioned. This arrangement allows much more X-light to strike the patient than is useful, for X-light spreads as a spherical wave from the radiant area on the target. This unnecessary X-light strikes the sides of the metal cylinder. Rœntgen and Tesla have

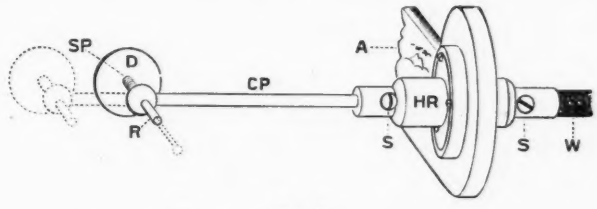


FIG. 2.

shown that metals reflect X-light as chalk does light of longer waves. Other observers have shown that every metal surface on which X-light strikes becomes a source of light having some similar properties. It is evident, therefore, that the use of a metal tube introduces ele-

ments of fog to the photographic plate, because the extra reflected and transformed light suffers diffusion in the tissues (note x), blurring the image on the plate; for it is not of the right kind and is not direct light arising from a small point, but from a very wide area, and therefore incapable of making sharp shadows. If we wish to get the exceedingly sharp images of objects which X-light, when scientifically used, can give us, we must exclude as far as possible all X-light except what arises from the small radiant area of the target. (Consult note xli and supplement, where a figure of a tube having an internal diaphragm is shown). This important principle is one of my X-light axioms, and may be stated in the following words. Axiom sixth: In making photographs by X-light only the beam arising from the radiant area on the target should be allowed to strike the photographic plate. I made projecting metal tubes such as I have criticised in the summer of 1896, when less was known, but abandoned the plan of having the interior surfaces of metal except for therapeutic purposes. For this work I later used cones (consult note cxliv, note clvi, Figs. 3 and 4) instead of cylinders, thereby turning a defect into a benefit, because the reflected X-light was useful, increasing the intensity of the illumination, shortening the exposure required in treating diseases of skin and tissues near the surface, for which the reflected light was of suitable quality. Moreover, it allowed the light to be turned around a corner, a feature of importance in treating diseases of the mouth and other cavities and affections of the prostrate and other glands near the surface, where it is not easy to use the direct beam on account of inconvenience to the patient. If one wishes to use tubes between the X-light tube and the patient in photographic work, they should be made of fibre or wood or some similar material and painted on the inside with white lead to make them non-radiable. The proper place to attach such tubes is not to the examination table on which the patient is placed, but to my non-radiable tube-boxes from which no X-light can escape except through the metal tube (Figs. 3 and 4, note clvi). The X-light tube and its box should always be on an independent support, so that any part of the patient may be quickly brought into proper relations to the source of light. I found all methods of attaching the tube to the support on which the patient was placed were unwise except in certain special cases like those developed by Moritz for drawing the outlines of the internal organs. The cross-section of the metal tubes I criticise is a circle. Therefore, either some of the photographic plate will be wasted or the tissues will be illuminated unnecessarily. Consult here note cxlix, Fig. 1. If such cylinders are used for fluoroscopic work, the cryptoscope must be larger than needed or else there will be unnecessary illumination of the tissues. Size is of importance with properly constructed cryptoscopes, which are heavy when they are non-radiable, as I have shown they must be. The author might escape these difficulties by using round plates and cryptoscopes, but this does not seem very practical at present for photographic plates, though for cryptoscopes the construction is not objectionable for some work, and for special cases I have figured such round cryptoscopes, in my smaller seehear, for example. If metal tubes are used between the X-light tube and the patient, the cross-section may therefore well be rectangular as in the figures of my concentrating pyramids already illustrated. In regard to the supports for such tubes, I recommend the arrangements I have described in which the tube is mounted on an independent support, the patient on a freely movable table for horizontal positions or on a similarly freely movable platform for standing or sitting positions, as being more practical, for it admits of more rapid adjustment.

ELECTRIC MINING NOTES.

BY SYDNEY F. WALKER.

THE HOME OFFICE ENQUIRY INTO THE USE OF ELECTRICITY IN COAL MINES.

A committee has been sitting for some months at the Home Office enquiring into the conditions, dangers, etc., attendant on the use of electricity in the coal mines of the United Kingdom. It will perhaps be as well to explain that in this country the administration of the somewhat numerous acts of Parliament, designed for the regulation of working in coal mines, are all under the control of the Home Office, the ministerial department, which corresponds to the Interior in most countries —the department which is responsible for the London police, for the administration of things appertaining to the inside of the Kingdom not provided for by the Board of Trade, the Local Government Board, the Education Board, etc. The actual working of the different acts is watched over by an able and continually growing body of trained mining engineers, which is responsible to the Home Secretary, and whose headquarters are at the Home Office. It should perhaps also be explained that the several acts of Parliament have been passed, largely in deference to public opinion, for the purpose of bettering the lot of the working miner, and for rendering the risks he runs in his ordinary labors much less. What work was in mines fifty or more years ago, may be seen from a perusal of Disraeli's novel "Sybil," in which the conditions of the working classes are very vividly described. In those days women worked in coal mines by the side of men, and under conditions which practically unsexed them. Both men and women who worked in the coal mines of those days often did not see daylight for days, at least, together. In those days explosions, though fairly frequent, did not do much harm, as there was not much gas in the shallow seams which were worked then, and the extent of the mines themselves and the strength of the ventilating current were both so small that the damage was confined to the immediate neighborhood of the seat of the explosion, and was usually not serious there. In those days safety lamps were not used. The working miner carried his life in his hands, and was very skilful in detecting gas with the aid only of the candle he used to light him, and equally skilful in getting rid of the gas by the aid of his coat used as a fan. Now all that is changed. The movement which was initiated by the late Lord Shaftesbury, which had for its object the betterment of the condition of the working classes generally, has borne fruit in mining perhaps more than in any other industry. In fact there is a strong feeling that the colliery owner in this country is being seriously handicapped by legislation, particularly in view of the fact that severe competition may be expected from America, as soon as the coal fields on this side have had time to develop. This is of course denied, not only by colliery owners, but by the miners' leaders, the same arguments being used against the possibility of American competition that were used against the competition in the wheat industry, which has been practically destroyed. On the other hand, it is a well-known fact that there is a constant dribble of life and limb in coal mining which far exceeds the losses due to the explosions which occur from time to time. Explosions have become less and less frequent, as the years have rolled on, owing to the development of engineering, and the better laying out of the mines them-

selves; but on the other hand, when an explosion does occur, it is a fortunate accident if it does not take toll of several hundreds of lives, and does not damage the mine itself to the tune of several tens of thousands of pounds. Mines now are very extensive, and powerful ventilating currents sweep over every part of them, with the result that if gas or coal dust is ignited in any portion the ventilating current carries the heat to every part of the mine, often causing fresh explosions from fresh ignitions of masses of coal dust, which have been raised in a cloud by the force of the original explosion.

The development of coal mines, the necessity for working the lower and the thinner seams, the upper and thicker having been largely worked out, has led to difficult problems in transmitting power to pumps, haulage engines, and to coal-cutting machines. The power required has been increasing very rapidly, and the distance from the surface has been increasing also. Some idea of this may be obtained from the fact that in one colliery in Derbyshire alone, there are twenty coal-cutting machines working at the face of the coal, which may be as much as a mile from the pit bottom, the pit itself being from four hundred yards upward in depth. This alone means a possible 500 horse-power, and in addition there is the power required to haul the coal to the pit bottom when it is hewed and filled into trams, and the power required for pumping the water which is so frequently found at these low depths. Practically there are now only two methods of transmitting the power available—compressed air and electricity. Compressed air has held the field for a great many years, but it has been gradually ousted by electricity, as the power required has become greater, and the distances longer. Mining engineers find that they can not rely upon more than a return of twenty-five per cent with compressed air, while at least double that is obtainable with electricity, hence electricity has gradually come more and more into use. But there have been several deaths caused during the last few years by electricity, and that with pressures of only 500 volts and less, while somewhat similar accidents to those which have occurred in coal mines have occurred in other places, with pressures of only 200 volts. Hence there has arisen a feeling that electricity is unsafe. In addition, mining engineers have always looked askance at the electric motor, with its spark at the commutator, and at the possibility of sparks passing between the broken ends of a cable. The enquiry is being held at the Home Office, under the presidency of one of the permanent secretaries of the department, Mr. H. H. S. Cunningham, C. B., and consists of, in addition to the chairman, Mr. Charles Fenwick, M. P., one of the best known of the labor leaders; Mr. A. H. Stokes, one of H. M. inspectors of mines, who has had some experience with electricity in mining work, and is also a mining engineer of considerable experience. He was for many years assistant mines inspector in the same district, Derbyshire, Warwickshire, etc., where he is now the principal inspector, and is a coinventor of a special form of commutator for continuous-current machines, which is designed to render the possibility of the ignition of gas at the commutator impossible. Mr. W. W. Hood, another member, is a colliery owner of Scotland, and the manager of a large colliery in Glamorganshire. Mr. Hood was appointed in place of his father, Mr. Archibald Hood, on the death of the latter. Mr. Archibald Hood was an important figure and a well-known one in South Wales and Scottish mining circles. Mr. Willie Hood, as he is usually called, served his apprenticeship under his father, and has been the manager of the Llwynpia collieries, in the Rhondda Valley, in Glamorganshire, for considerably over twenty years. Llwynpia colliery, which is known in the district as the Scotch pit, because it is so largely in the hands of Scotchmen, raises something like 1,000,000 tons of coal a year, and is noted for its use of machinery. Electricity has been largely used in the Llwynpia collieries for a number of years, for pumping, lighting and hauling. Mr. W. N. Atkinson, another of H. M. inspectors of mines, and Mr. James Swinburne, the president of the Institution of Electrical Engineers, appointed ex-officio, completed the rota.

Not much confidence is felt usually in this country in government enquiries. Royal commissions and departmental enquiries are looked upon as convenient methods of shelving inconvenient subjects. Occasionally, however, an enquiry does take place, which is of value, and, in the writer's opinion, the present enquiry into the use of electricity in mines is one of them. The committee has no power to compel anyone to give evidence, and it has no power to be liberal in the matter of expenses to witnesses. Witnesses are only allowed their bare out-of-pocket expenses, for train fares, etc., and a guinea a day for general expenses. It is interesting to note that it is the working-men witnesses who have kicked at this arrangement. It is also interesting to note that it appears to be the opinion of those who arouse these matters, that those who have anything to say on the subject should say it for the general benefit of the community as a whole. The secretary of the committee is Captain Desborough, of the explosives department of the Home Office. The Home Office carries out with the aid of trained artillery officers, continual experiments upon the different new forms of explosives that are presented for test. No explosive is allowed to be used for blasting in coal mines unless it is on what is termed "the permitted list," and before any new substance is placed upon the list, careful experiments are carried out at Woolwich, to thoroughly test it. It is also interesting to note that at first the committee sat with closed doors, the press being rigidly excluded, but in response to a vigorous protest in the *Colliery Manager,* the evidence was placed at the disposal of the technical press which were interested, with the request that the remarks of individual members of the committee should not be reported. The committee has one of the usual difficulties to meet, the desire of manufacturers to exploit the committee for their own benefit, to use it as a means of advertising their own wares. This difficulty it has apparently succeeded in overcoming, and it has drawn a good deal of valuable information from the witnesses.

The witnesses examined have consisted of manufacturers of electrical apparatus, who have supplied apparatus to collieries, contractors who have done the same, mining engineers, and colliery managers, working-men's representatives, in the form of their agents, and also miners actually engaged at the present time in the use of electrical apparatus in mines. It should perhaps be explained that on this side, as well, as the writer presumes, in America, the miners' leader has long since ceased to be a working-man, in the sense that he works with his own hands in the same manner as those he represents do. Of the miners' agents who were examined by the committee, one mentioned that he had had very little experience as a collier. His father had been an old collier, and he had worked in a coal mine as a lad, but that was a long time since. Others who had had long experience in working in coal mines had left actual labor for periods varying from a few years upwards. There was an amusing

incident in connection with the actual status of the miners' agents a few years back, during the progress of an election. A radical barrister put up for a constituency which was largely dominated by the miners' vote, and he was opposed by "Mabon" who was one of the most respected and one of the ablest of the miners' leaders. "Mabon," Mr. William Abraham, to give him his proper name, expressed the opinion that the barrister could hardly represent a miners' constituency, inasmuch as he was hardly a working-man. The barrister promptly retorted by asking what constituted a working-man. Was it sufficient to have worked in a mine thirty years since. If so, Sir George Elliot, one of the largest mine owners of that time, who commenced life as a door boy in a colliery in Durham, was a working-man, and he proceeded to ask whether "Mabon" who owned a comfortable villa standing in its own grounds, who was a director of public companies, and after whom a particular brand of tobacco had recently been named, could be called a working-man. "Mabon" did not reply. A good deal of time has been wasted, as is usual in enquiries of this kind, by the fact that each member of the committee thinks it necessary to put a series of questions on his own account, quite regardless of the fact that the points he wishes to bring out have been brought out by the answers to the questions of the other members. There is also a certain amount of jealousy between the members of the committee themselves.

The chairman is a lawyer, and with the training of a lawyer, usually covers the whole ground available from any particular witness in his examination, which takes precedence of all the others, but the other members usually want to air their own views under the guise of questions to the witness. Notwithstanding all this, the information that has been extracted is of great value. One important fact that has been elicited from the miners' agents is that they are no longer hostile to the use of machinery. When the present writer carried out the enquiry into the use of coal-cutting machines in mines for the *Colliery Guardian,* one of the most important points which came under his notice was the fact that in many cases the use of coal-cutting machines had been deliberately rendered unprofitable, by the miners refusing to fill the coal which had been cut by the machine at a price which would enable the coal owner to reap the advantage of his machine. Now all that has passed, and the change is due to the visit which "Mabon" paid to America some months since. On his return he announced that it would be unwise to resist the introduction of machinery into mines, and other miners' leaders have followed suit. "Mabon's" conversion has been one of the most important factors in the British mining industrial problem that has materialised for many a long year. The miners' agents naturally ask that their clients shall be protected in the use of machines, and in this connection a most important fact has come out, which was also alluded to by the present writer in the book which was the result of his enquiry into the coal-cutting question. One of the dangers of coal mining, one of the most important factors in the dribble of lives that goes on, is the uncertainty of the roof at the working face of the coal, where the coal is being extracted from its bed. It will be understood that as the coal is removed a strain is brought upon the overlying strata, which forms the roof of the road in which the miner is working. How long it will stand depends upon a good many things; such as its cohesive force, the weight of the strata immediately above it, the arrangement of the timber which supports it, and so on. But when the roof is about to fall, it gives warning by noises well known to the practical miner, and usually, if he is not a careless man, gives him plenty of time to get out of its way, or to prop it up. When a coal-cutting machine is at work, the noise of the machine completely drowns all these sounds, upon which the lives of those who are working the machine depend, and it does not appear to make any difference whether the machine is run by electricity or by compressed air. The electric motor, with its gearing, makes less noise than the compressed air motor, but the noise of the electric motor and gearing is more than sufficient to drown any of the noises mentioned. One of the things to be sought after is evidently a noiseless apparatus, and in this connection it is evident that electricity has much the best chance of success. At present there is no known method of running a motor which is using compressed air without noise. The expansion of the air issuing from the exhaust port is very noisy. The present rule, therefore, is to stop very frequently to listen for warning sounds, and to examine the roof; and the miners' agents were unanimous in recommending the course which the present writer recommended in his book on the subject, that miners who had acquired a knowledge of mechanics and electricity were much better for working coal-cutting machines than mechanics or electricians who had acquired a certain familiarity with mining. Working in a mine continuously requires a certain training, just as working on board ship does. The landsman feels very uncomfortable at the sight even of a sailor at the yard arm of a sailing ship, while the sailor himself feels quite at home. Similarly, the miner who has been brought up in a mine feels quite at home under conditions where the ordinary individual would feel like a rat in a hole. And there are some very uncomfortable positions where coal-cutting machines have to be worked—in thin coal seams. The present writer inspected a coal-cutting machine at work, in a seam where he had to assume the position of a frog, or a grasshopper, for a considerable length of time, while he was watching the machine at work, and he found it very tiring; and the conditions in this case, so far as personal comfort was concerned, were not what Artemus Ward would call a "circumstance" compared with some in which work has to be carried on. In one case, for instance, one of H. M. inspectors of mines informed the writer that he had to crawl into a place on his stomach, and was unable to crawl out again, he had to be pulled out by his feet. There is also a record case where a hewer had to be pulled out by the feet every time he wanted to turn over his pick. In some of the low seams also locomotion assumes a somewhat painful aspect. The men who work in the seams every day get into a sort of grasshopper-like spring, the body being kept all the time at half its normal height. In other cases, as in the west of Yorkshire, the men who work in the thin seams propel themselves upon low trucks, on rails, the men lying on their stomachs on the trucks, and propelling them by kicking the side of the road with one foot. Men who are constantly working under these conditions get quite accustomed to them, and they are not really dangerous, just as a sailor on a topsail-yard is really in no more danger, as long as he is in good health, than he is on the deck. But to those who are not accustomed to these things, there is real danger, and men are taken up very much more with the matter of their own danger and their own comfort than with looking after a machine. On the other hand, a smart miner soon gets to know enough to keep his own machine going. His repairs may make the skilled mechanic raise his eyebrows, but he keeps the machine going, and that is everything, and meanwhile the man is at home practically where he is working.

(To be continued.)

Notes from Great Britain.

By Our Special Correspondent.

ONE of the most important possibilities of the large "bulk" supply companies in the United Kingdom has just been experienced at Willesden, London. The two interested parties are the Willesden Urban District Council and the North Metropolitan Electrical Power Distribution Company. The former local authority some years ago obtained a provisional electric lighting order and had gone so far with its electrical undertaking as to spend some $300,000 upon its generating station, and was hoping shortly to give a supply, while the latter company has powers to supply electric power "in bulk" over a large portion of northern Middlesex, adjacent to the area of the Willesden Urban District Council. The company, which has been in possession of its powers for a few years, has made but few outward and visible signs of developing the area given to it beyond a couple of temporary stations supplying small portions. But the proposal which has just been made to the Willesden Urban District Council, *viz.*, to take over the generating station now being erected by it and to utilize it for the general purposes of its own parliamentary powers, and to supply electricity in bulk to the local authority, is one which it will make manifest, much more quickly than would otherwise have been the case. The terms of the agreement provide for the supply of current immediately at an equal price, but, of course, without the responsibility of the financial problems involved, as the company offers to defray the cost of the expenditure to date, either in cost or by paying the annual instalments for interest and sinking fund until the debt was completed.

The latest official information concerning the government telephone system is that the expenditure to date is over $5,000,000. Seven exchanges have been opened within the past twelve months, and in addition to some 9,000 telephones in use about 2,000 further agreements have been entered into, and 150 to 200 new subscribers are being connected up. Some delay has been experienced in obtaining way leaves and this has been instrumental in preventing consumers in certain districts being connected up. The consequence has been some complaints to the government. Four other important exchanges will be opened during the course of the year, and arrangements are in progress for the erection of several others.

Great satisfaction has been expressed at the decision of the government to contribute toward the funds of the Engineering Standards Committee. As its name implies, the work of this body is the preparation of engineering standards, including standard specifications for engineering works, together with the standardization of parts of locomotives and electrical appliances. This work the government regards as tending to reduce the cost of production and the time occupied in completion. The sum proposed to be set aside to facilitate the work of the committee for the present financial year is $15,000, and a special committee has been appointed to administer this sum, which goes into a common fund. The members of the Engineering Standards Committee are eminent members of the Institutions of Civil, Mechanical and Electrical Engineers, and the present hope is the formation of a permanent body, in order to keep in touch with the scientific and practical development of the trades concerned, and be prepared to revise the standards by addition or deletion, and to modify the methods of testing as necessity arises.

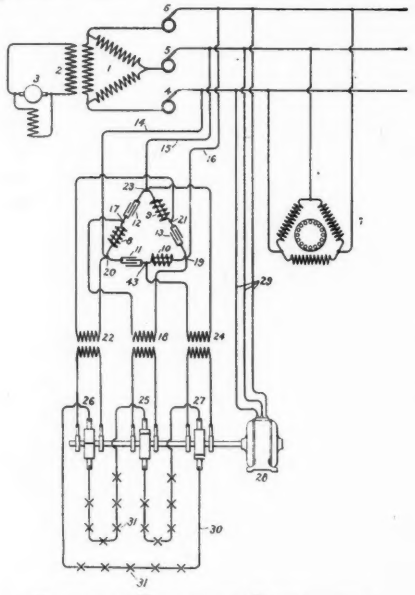
A good deal of discussion has taken place of late in connection with the proposal of the London County Council to undertake the wiring of premises for the electric light. Strenuous opposition was put up by the London wiring contractors, supported by the London Electrical Contractors' Association, and eventually Parliament refused to allow the clauses of the bill relating to this matter to proceed. The whole argument has been fought around the difference between undertaking free wiring, *i. e.*, the consumer paying a little more per unit for his current in return for the local authority providing his wires and fittings free, and the actual installation work being carried out by the workmen of the local authority. A good deal of misunderstanding has arisen. At a conference upon this matter held recently, between some local authorities, electric supply companies and contractors, the former averred that the actual carrying out of the work was never intended by them, but at the same time no specific mention of this was made in the bill of the London County Council, nor does this attitude appear to have been the generally accepted one; because the local Government Board, which has to sanction the municipal loans, has for some time now refused to grant sums of money for free wiring purposes, being obviously under the impression that a competition with the local wiring contractor was intended. The position has so far been cleared up that we are now in this position. The London contractors are willing to support any bill coming to Parliament seeking powers to undertake free wiring, provided it is specifically stated that no actual installation work will be carried out, and that all work of this description will be put out to contract. If this is adopted by the local authorities, an immense deal of good will be done to the electric lighting industry, inasmuch as it will increase the station load in the poorer districts by enabling workmen and others to have the light, but who can not afford to pay the initial cost of the fittings.

Means of locomotion in London seem to afford a never-ending topic of conversation and discussion, and to all appearances this is a state of things likely to last no inconsiderable length of time. At the present moment there are many things to talk about. First of all there is the rejection of a large electric railway, partly in tube and partly on the surface, running from the heart of the city to the north and northeast of London. It is—or was—proposed to practically transfer a number of companies sanctioned by Parliament, and over which Parliament would have full control, to a company registered under the companies acts, and over which Parliament could exercise no authority. The proposition in question was rejected in the case of one of the railways this year and has since been abandoned, for this year at any rate, in connection with the others. Finally, there are the propositions of the London County Council before the Royal Commission which is considering the question of traffic in London. The County Council proposes that it should be the sole tramway authority, that hitherto all railway schemes should be sanctioned for only a given number of years, and that they should then revert to the Council. A. W.

London, May 23.

Electrical Patents.

The General Electric Company, of New York, controls a patent recently issued on a new system of electrical distribution, devised by Mr. Edwin W. Rice, Jr., of Schenectady, N. Y. The invention relates to means for deriving a rectified constant current from a source of alternating current of approximately constant potential, and includes among its features of novelty certain improvements in the manner of obtaining the constant current to be rectified, as well as in the arrangements for rectifying the same. In the cut there is illustrated means for generating multiphase alternating current, in this case three-phase, the multiphase alternating current thus produced being passed through a constant-potential constant-current transforming apparatus and then to a rectifying commutator, the whole arrangement being represented in diagram. The source of three-phase current is represented conventionally by the triangular arrangement of windings 1, which indicates generating windings of a three-phase machine; the field winding 2 of which is excited by direct current derived from a suitable source, such as the exciter 3. The terminals 4, 5 and 6, connected to the generating windings, supply current to transmission lines correspondingly designated. To these transmission lines translating devices of any desired character may be connected. As typifying such translating devices there is indicated an induction motor 7, connected to the transmission lines. In order to derive the rectified constant current, which it is one of the objects of the invention to produce, there is connected to these transmission lines 4, 5 and 6 a constant-potential constant-current transforming apparatus, consisting in the present instance of a closed circuit, including reactances of opposite sign alternately arranged in series with respect to each other. These reactances may consist of inductance coils and condensers, the closed circuit including three of each arranged as specified. In the drawings these alternately connected inductance coils and condensers are indicated at 8 to 13, inclusive. Leads 14, 15 and 16 are connected, respectively, to the transmission lines 4, 5 and 6 and serve to convey alternating current of constant potential to the transforming device thus described. The points of connection of these leads with the closed circuit, including the inductance coils and condensers, are so chosen that each pair of the leads spans two adjacent reactances of opposite sign, that is to say, a condenser and its adjacent inductance coil. In the illustration these connections have been made so that the leads 14 and 15 are connected across the inductance coil 8 and the condenser 12, the leads 15 and 16 across the inductance coil 9 and the condenser 13, and the leads 16 and 14 across the inductance coil 10 and a condenser 11. Constant-potential alternating current being now supplied to this combination of reactances in which there is an inductance coil and a condenser in series across each pair of leads, there is produced across the terminals of any one of the condensers or inductance coils an electromotive force which appears at right angles or in quadrature to that impressed upon the terminals of that pair of reactances to which the particular condenser or inductance coil belongs. To produce this result, the condenser and

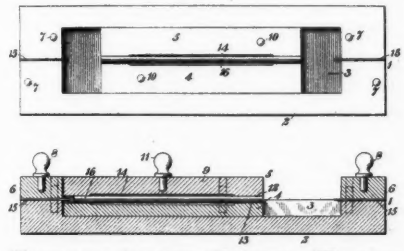


System of Electrical Distribution.

inductance of each pair must be proportioned relatively to each other, so as to be in resonance condition, the manner of securing this proportioning being well understood by those skilled in the art. When thus proportioned, the electromotive force across the terminals of any one of the inductance coils or condensers is in quadrature with the impressed constant-potential electromotive force and varies in such a manner as would maintain a constant current in a circuit supplied thereby. This automatic regulation is not impaired, but is, on the contrary, increased in range and the regulation actually improved in some respects if an electromotive force of constant potential be included in circuit therewith, this electromotive force being preferably chosen so as to be in phase with that of the constant-current circuit. Three constant-current circuits of this character are represented. One of these circuits is connected at 17 to the junction between the inductance coil 8 and the condenser 12 and through the primary of a transformer 18 to the point 19 at the opposite angle of the triangular arrangement of reactances. The inductance coil 8 and the condenser 12 being supplied with current from the constant-potential mains 14 and 15 impress upon this circuit 17, 19 an electromotive force which regulates for constant current, this electromotive force, however, being combined with the resultant of the two electromotive forces between the leads 15, 16 and 14, 16, respectively, this resultant being, as will be readily understood, at right angles to that between the leads 14 and 15, and therefore in phase with the constant-current electromotive force derived from the inductance coil 8 and the condenser 12. In a similar manner a second constant-current circuit is connected between the point 20 corresponding to the lead 14 and the point 21 between the inductance coil 9 and the condenser 13, which are in series across the two remaining leads 15 and 16, this constant-current circuit likewise including the primary of a transformer 22. A third constant-current circuit is connected to a point 23 representing the junction of the lead 15 with the transforming apparatus and a point 43 between the inductance coil 10 and condenser 11 in series across the other two leads 14 and 16, this last constant-current circuit likewise including the primary of still another transformer 24. The secondaries of the transformers 18, 22 and 24 are connected, respectively, to rectifying commutators 25, 26 and 27, these commutators being driven in synchronism with the waves of the alternating current. Any suitable means is employed for this purpose, as, for example, a synchronous motor 28, this motor being supplied with alternating current through the leads 29, connected to the transmission lines 4, 5 and 6. The direct current for exciting the motor may be derived from a suitable source. (Not here shown.) The respective rectifying commutators 25, 26 and 27, which may be of any ordinary type, are connected in series with each other through the medium of a consumption circuit 30, including translating devices of any desired character, as, for example, arc lamps, indicated conventionally by the crosses, such as at 31. To reduce the maximum difference of potential existing between any two points of this circuit, some of these translating devices

may be interposed in a circuit joining each pair of rectifying commutators in series, this arrangement of translating devices being well understood in the art and commonly designated as a "multicircuit" connection. One object of interposing the transformers 18, 22 and 24 is to render the respective constant-current circuits to which they are connected electrically independent of each other, thereby permitting the several constant-current circuits to be connected in series with each other, if so desired. Moreover, the transformers by saturation of their cores limit the constant-current voltage in case of open-circuit at the rectifier.

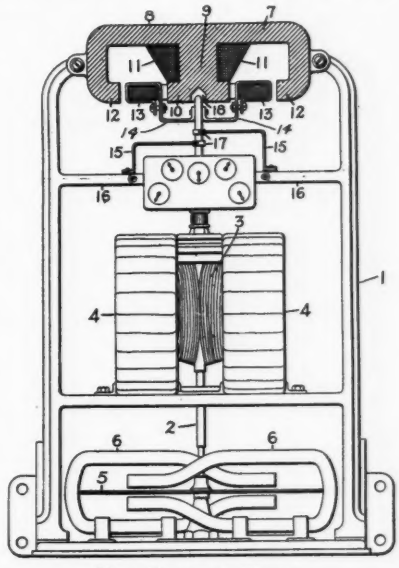
A new method of applying terminal wires to electric lamp glowers has been patented by Mr. Joseph M. Gulentz, of Pittsburg, Pa., and Mr. George Westinghouse has purchased this patent. The means comprises a rectangular frame 1, the base portion 2 of which is provided with an oblong rectangular recess or guideway 3, and in this recess is mounted the bottom portion 4 of two-part block 5, this block being of less length than the recess or guideway 3, but of substantially the same width, it being fitted, however, so as to slide easily therein. The frame 1 comprises a clamping block or piece 6 at each end, which is suitably fastened to the base portion 2, the means here shown being dowel-pins 7, which project upward from



METHOD OF APPLYING TERMINAL WIRES TO ELECTRIC LAMP GLOWERS.

the base and fit into corresponding holes in the pieces 6. These pieces 6 are also provided with handles 8, by means of which they may be placed in and removed from their operative positions in the apparatus. The top part 9 of the block 5 is fastened to the bottom part 4 by dowel-pins 10, projecting upward from the lower part and fitted into corresponding holes in the upper part. This part 9 is also provided with a handle 11, by means of which it may be placed in and removed from its operative position. The two ends of the parts 4 and 9 are provided with registering semi-cylindrical recesses 12 and 13 of the right dimensions to receive a glower blank. The parts are also hollowed out to form an enlarged semi-cylindrical recess 14. The parts 2 and 6 are also preferably provided with small registering grooves to receive the terminal wires 15, the grooves being of such dimensions that the wires may be clamped firmly in position, so that the amount of terminal wire end which it is desired to insert into the glower blank shall project within the recess 3 at the upper side thereof. In applying the terminal wires 15, an unbaked and comparatively soft glower blank 16 is placed in the clamp block 5 and the terminal wires 15 are located in the ends of the frame 1, so that they shall be clamped in position by means of the pieces 6. The block 5 is then moved longitudinally in the one direction or the other, which will serve to force the end of the terminal wire into the end of the blank. The piece 6 at that end may then be raised slightly or entirely removed to release the wire 15 and the block be then moved in the guideway to the other end thereof, thus forcing the end of the right-hand terminal wire into the corresponding end of the glower blank. The glower blank and its terminal wires may then be removed from the apparatus and a suitable paste 17 applied to the ends of the blank. The device is then baked or otherwise subjected to any treatment which may be necessary or desirable to put it in condition for service, the resulting glower being then ready for use, except for attachment of additional lengths of lead wires to the terminal wires 15, it being the usual practice to employ platinum for the terminal wires 15 and to fuse additional lengths of wire of less expensive material to the ends of these terminal wires.

Mr. Walter C. Fish, of Lynn, Mass., has assigned to the General Electric Company a patent obtained on a meter invented by Mr. Fish. In electric meters of the ordinary construction the armature shaft is vertically disposed. Owing to the accurate operation required of these meters, it is desirable that the friction between the shaft and its bearings be made as light as possible. In order to decrease this friction, Mr. Fish employs a symmetrical current-carrying coil in conjunction with an electromagnet system for the purpose of reducing the pressure between the shaft and its journal. One of these members is carried by the armature shaft and the other by the frame of the meter. The casing of a wattmeter of ordinary construction is shown at 1, in which the vertical shaft 2, which carries the armature 3, is mounted; 4 represents the field coils of the meter. A disc 5 and magnets 6, of the ordinary construction, for retarding the movement of the armature, are shown. At the top of the casing is placed an electromagnet 7. This electromagnet is formed like an inverted cup, the bottom, 8, of which is circular and forms the yoke of the electromagnet. Rising from the bottom at the centre is the core 9, which is cylindrical in form and carries at its top the enlarged cylindrical disc-shaped pole-piece 10. Between the cylindrical enlargement 10 and the bottom 8 is wound the coil 11 for energizing the electromagnet. The sides of the cup are turned in, so that a portion 12, which is annular in shape, is in the same plane with the cylindrical enlargement 10. The magnetic flux of the electromagnet passes, therefore, in substantially radial directions between the centre of the cylindrical portion 10 and the inner surface of the extension 12. Carried at the upper end of the armature shaft 2 is an annular coil 13. This coil is symmetrically wound and is so placed as to lie in a horizontal plane between the cylindrical portion 10 and the inner extension 12 of the magnet 7. Arms 14 are clamped or secured to the armature shaft 2 in any desirable manner and support at their outer ends the coil 13. Brushes 15, supported in any suitable manner—as, for instance, by being mounted on a cross-arm 16, carried by the casing—contact with slip-rings 17, which are carried by the armature shaft 2. These slip-rings convey current to the coil 13, and the brushes 15 receive current from any suitable source. Preferably the current which energizes the coil 13 is the potential current of the wattmeter, and the brushes, connections, coil, etc., form part of the resistance in the



NEW ELECTRIC METER.

potential circuit. The coil 11 may also be included in this circuit if desired. A recess 18 may be formed in the end of the cylindrical portion 10, if desired, in which the upper end of the shaft 2 may be guided. If the coils are properly proportioned and located, the passage of current through them will in either case tend to raise the armature shaft. A variation of the amount of current passed through the coils will have, however, but slight effect on the displacement given to the shaft, as a very slight elevation of the coil would lift them out of the position of strongest effect upon the other member. With this invention there is little liability of trouble due to any side strain, as the coil can be wound in a very symmetrical manner and as any slight imperfection in proportion will have but very little influence in producing side strain.

Reviews of Current Engineering and Scientific Literature.

Artemieff's Electrical Armor.

In this article M. A. Giron describes a protecting armor, which consists of a suit of clothing of fine wire cloth, covering all parts of the body. The wire is covered with cloth to make it more durable. This armor is now being manufactured by the Siemens & Halske Company, of Berlin, in three sizes. It has been tested under severe conditions, and in all cases protected the experimenter from shocks. It protects in two ways. First, it prevents short-circuits through the body by providing a low-resistance path around it. Thus, the resistance of this covering from hand to hand is less than 0.01 ohm, while that of the body is generally greater than 2,000 ohms. Therefore, a short-circuit, sending 1,000 amperes through the armor, would give a voltage of only ten across the body, which could not pass more than 0.005 of an ampere. The second protection is that of preventing high-tension voltages from setting up charging currents in the body. It has been tested in this way with voltages of 200,000. Care should be taken, however, to avoid drawing arcs to the armor, as this may not only destroy the armor, but cause severe burns.—*Translated and abstracted from l'Electricien (Paris), May* 16.

Hertzian Wave Wireless Telegraphy.

This is the first section of a series of articles by Dr. J. A. Fleming upon wireless telegraphy, based on the Cantor lectures delivered before the London Society of Arts, in March of this year. Dr. Fleming has revised his lectures, and omitted advanced technicalities, in order that the subject may be suitable for the general reader. He explains clearly the accepted ideas in regard to the action of the ether when subjected to an electric strain. He shows how electrical waves may be thrown out, which travel along a line perpendicular to the radiator. As an alternating charge is impressed upon a conductor, this charge sets up in the surrounding ether an alternating strain, which strain travels outward in the form of self-enclosed lines. At each oscillation of the charges, the direction of the lines of strain springing from end to end of the radiator is reversed. It is a general property of lines of strain that there is a tension along the line, and a pressure at right angles, hence these loops of electric strain press each other out. Each one that is formed squeezes the already formed loops further and further away from the radiator. This movement through the ether of self-enclosed lines of electric strain constitutes what is called electric radiation. The author then explains three principal types of radiator—the simple Marconi radiator, which is charged by means of an induction coil, and which discharges to the earth across an air-gap; the Braun radiator, in which the aerial wire is connected to some part of an oscillating circuit; and the Marconi-Braun system, in which the oscillations are set up in one circuit, and impressed upon an aerial wire through a transformer. The energy radiated depends upon the capacity of the aerial wire and the charging voltage. By means of the transformer the charging voltage can be made high. The capacity may be increased by erecting a system of multiple aerials, but by this arrangement the capacity does not increase proportionally with the increased wire used.—*Abstracted from the Popular Science Monthly (New York), June.*

Electric Lighting of the Aldershot Camps.

The electrical installation at Aldershot, England, which is the largest private electrical installation in the world, is nearing completion. The boiler house contains six boilers, each fed from a separate coal bunker. These are hand fired, with a duplicate water feed system, consisting of three-throw feed pumps driven by series motors. There are two economizers which may be used singly or in parallel. The engine room equipment consists of three Parsons turbines, direct-coupled to Parsons two-pole over-type 250-kilowatt generators. These machines run at 2,000 to 2,200 revolutions per minute, and are automatically lubricated. The bed-plate is arranged as an oil tank, and fitted with cooling pipes. It is not bolted down, but stands on wooden blocks resting upon concrete foundations. Regulation is accomplished by means of an electrical governor consisting of a solenoid and plunger acting against the spiral of a spiral spring. Each turbine is also fitted with a centrifugal governor. Current is distributed at 400 and 450 volts. At full load the steam consumption per kilowatt-hour is 24.9 pounds, with a 26.75-inch vacuum and 131 pounds pressure of steam at the stop valve. Under similar conditions at half load the consumption was 29.41 pounds, and at quarter load, 37.75 pounds. There is also one 100-kilowatt turbo-generator, with two dynamos mounted tandem on the shaft, which may be used as a steam balancer. It runs at 4,000 revolutions per minute. For boosting and balancing, four machines are mounted on one shaft, and comprise two compound-wound machines capable of dealing with 100 amperes out of balance, and driving two generators, each capable of raising the pressure 100 volts when 250 amperes is passing through them. The condensers are fitted with a release valve which automatically opens the exhaust to the air should the vacuum fail. Water is circulated through the condenser by a centrifugal pump. The switchboard contains a panel for each generator, fourteen feeder panels, balancing and booster panels, and a station panel. The whole board is arranged for two pressures, so that boosted feeders may be used for supplying distant points. The storage battery used for regulation consists of 230 cells, with a capacity of 100 amperes for ten hours, and has twenty-one regulating cells at each outer end. Current is distributed by a lead-covered three-core cable, laid solid. There are about 16,000 eight-candle-power lamps in inside lighting, and thirty-two arc lamps and about 700 incandescent lamps for outside lighting. About 100 horse-power of motors are in use.—*Abstracted from the Electrician (London), May* 15.

Magnetic Hysteresis at High Frequencies.

It has generally been assumed that the loss of energy due to hysteresis is independent of the frequency, but investigations to decide this question have given contradictory results. The chief difficulty has been in eliminating the hysteresis effects, as these not only cause a loss of energy, but weaken the magnetic density within the iron, so that there has always been uncertainty as to the actual value of this density. MM. C. E. Guye and B. Herzfeld have used a neat arrangement for investigating this matter. Two small wires, made from the same iron, were arranged symmetrically as two

branches of a bolometer. On each of these were wound similar bobbins having two sections, so that the windings on each wire could be made to assist or neutralize each other. First, a current was passed through the exciting coils, with these arranged so that no magnetic field was set up, and equilibrium was established by means of a galvanometer. This adjustment was corrected for temperature changes due to the Joule loss in the windings. The two coils were connected in series. By changing the connections so that two sections of one coil acted together, an alternating flux was set up in one branch of the bolometer. The iron wire used was small, so that it reached a constant temperature almost at once. By readjusting the apparatus to establish equilibrium again, a reading was obtained proportional to the heating of the magnetized arm of the bolometer. Experiments were carried out for different current densities and frequencies varying from 100 to 1,200 cycles per second. Four sizes of wire were used, being, respectively, 0.0374 centimetre, 0.0235 centimetre, 0.0155 centimetre and 0.0038 centimetre. The density of the field used for the different experiments varied from 56.6 to 9.4 centimetre-gramme-second units. Assuming the iron loss to be made up of a term due to hysteresis proportional to the frequency, and the second term due to Foucault currents proportional to the square of the frequency, curves were calculated for the conditions of the tests. This calculated curve did not agree with the experimental results for the largest size of wire. For the other sizes the curves agreed excellently, and for the smallest size of wire the results gave a straight line. The results showed also that the curve approached a straight line for low values of induction, and for very small wire the Foucault losses become negligible. The results seem to show that the hysteresis loss is independent of frequency up to 1,200 cycles per second.—*Translated and abstracted from l'Industrie Electrique (Paris), May 10.*

Rational Operation of Arc-Light Systems.

Operating engineers are always seeking for ways of reducing the cost of operating electric stations, and particularly that of producing the current. Herr R. Herzog here calls attention to a neglected phase of operation, which is the careless use of the carbons. With the price of current at twenty pfennigs (five cents) per kilowatt-hour, the cost of carbons is about fifteen per cent of the total cost of operating the lamps. In larger stations, where the cost of operation is proportionally less, the cost of the carbons may be eighteen per cent. In order to use the carbons most economically, they should be made in lengths proportional to the hours of lighting. Another point which has been neglected is the use of carbons of different diameters. The volume of a carbon is proportional to the square of its diameter, so that this should vary with the length of the carbon. There are limits, however, which should not be passed. The low limit for the large carbons is that where hissing is produced by the short arc. The upper limit for smaller carbons is where flickering begins. A graphical construction gives a simple way of determining the proper length of carbon for any time of lighting. The coordinates of the diagram are length of carbon and hours of lighting. A certain constant minimum length of carbon must be assumed to prevent burning of the holders. Then, by experiment, the consumption for different diameters can be determined, and by laying these off on coordinate paper, and drawing lines through points thus determined from the assumed minimum length, the proper length of any size of carbon for any time of lighting is easily determined. In this way the waste of carbon should be reduced to a minimum. A difficulty in this method arises because arc lamps are usually manufactured for only one size of carbon; but by using an adjustable holder, this difficulty is overcome.—*Translated and abstracted from the Elektrotechnischer Anzeiger (Berlin), May 14.*

The Lorain Surface Contact System at Wolverhampton, England.

The Lorain surface contact system has been in operation at Wolverhampton, England, for over a year, and this article gives a full abstract of the report of Mr. C. E. C. Shawfield, borough electrical and tramway engineer, for the system during this period. A little over eleven miles of single track have been in operation, with an average of about fifteen cars in service. The car-miles have been about 45,000 per month for the last six months. After stating the terms of the contract with the Lorain Steel Company, the report discusses the safety of the system, under two heads—obstruction to traffic, and possibility of injury from electric shock. There is no record of any accident due to the projecting contacts, so there seems to be no actual obstruction. Records have been kept of the shocks to persons and animals. There were seven of these, all of them occurring during the month of May, 1902, and which were caused by defective work in erection. There has been no fatal accident whatever, the most serious being the falling of horses, due to shocks. The engineer expresses the opinion that this system is no more dangerous than is overhead trolley construction. Discussing the reliability of the system, it is shown that 680 car-miles were lost, due to breakdowns, but of this loss only twelve and one-half per cent was due to the track equipment, 595 miles being lost from defects in the car equipment. It is thought that the results show that on the score of reliability there is little to choose between the Lorain system and the overhead system. The consumption of electric energy per car-mile is more with the Lorain system, due to the energy required to excite the car magnets, due to the extra weight of the car equipment and due to leakage. As a comparison, it is stated that the corresponding current consumption with the overhead trolley system is about 1.15 units per car-mile, and with the Lorain system, 1.6. Assuming that the average price for the electrical energy will be 1.65 pence per unit, the additional cost for energy consumed by the Lorain system would be 0.41 penny per car-mile. A comparison is made of the cost of maintenance of the two systems. For track equipment this is given as 0.569 penny per car-mile for the Lorain, and 0.316 penny per car-mile for the overhead system. The cost of maintenance for the car equipment in the Lorain system is 0.23 penny per car-mile, as against 0.08 penny per car-mile for the overhead system. This makes the total maintenance charges 0.799 penny per car-mile for the Lorain system, and 0.396 for the overhead system. The cost in pence for the energy per car-mile for the Lorain system is given as 3.109, and 2.296 for the overhead system. This shows that the total additional cost of working the Lorain system, as compared with the overhead system, is equivalent to 0.813 penny per car-mile. The above figures do not include any interest for sinking fund or extra capital expenditure that would be incurred for the Lorain system, but the report states that this extra capital expenditure on the Lorain system, including both track equipment and car equipment, may be taken as £1,250 per mile of single track.—*Abstracted from the Tramway and Railway World (London), May 14.*

STATIC DISCHARGES IN ELECTRIC CIRCUITS.[1]

BY PERCY H. THOMAS.

"Static discharges" in electric circuits supply a very interesting and instructive example of one of the most universal of nature's methods, namely, wave motion. Broadly speaking, wave motion serves as a method of transfer of energy. This transference is accomplished by the continuous development of force in a suitable medium, starting from the source of energy and passing to the receiving point. Such energy transfer may be accomplished either through a rigid or an electric medium. The electric waves constituting static disturbances are of the latter type. An "elastic" medium must contain inertia and elasticity, which, in electrical terms, means inductance and capacity. With a rigid medium, such as a connecting rod, the motion at the receiving point is exactly coincident with that at the source. With elastic transmission, there is a relatively large time lag or phase difference between these points.

When waves are started in a tubular medium, that is, one in which there is no spreading of the wave as it passes along, provided there are no wastes of energy in the transmission, the wave will preserve its original energy and form indefinitely. Any wastes of energy, however, cause a diminution of energy and a modification of form as the wave proceeds. The amount of energy in the wave and its form are determined by the generator at the instant of its creation, and can not be altered by any subsequent action of the generator.

Velocity—All waves pass with approximately the same velocity in any given medium.

Reflection—When the end of the medium or transmission wire is reached, the wave is reflected back to the generator backward over the same path, and produces at the moment of reflection double potential at the reflecting point. If instead of an abrupt end of the medium or wire, a sudden enlargement of the medium or a short-circuit for the wire is reached, the wave will still be reflected backward toward the generator, but with its sine reversed. When a change occurs in the medium, that is, in the inductance or capacity of the electric wire, there will be a partial reflection of the wave. If the capacity be increased at the reflecting point, the portion of the wave reflected will have its sine reversed and the portion proceeding will have a less voltage than the original wave. If the capacity be decreased at the reflecting point, the portion of the wave reflected will not have its sine reversed and the portion proceeding will have a greater voltage than the original wave.

Wave-Lengths—The wave-length is the distance a wave will travel, while the source (which is an assumed periodic) completes one period. Evidently in electric lines, on account of the enormous velocity of electric waves in air (approximately the velocity of light), only extremely rapid periods can generate waves. In fact, waves are generated only by static disturbances.

Any abrupt disturbance on a high-tension line, such as may be caused by switching grounds, short-circuits, lightning, etc., sends electric waves in all possible directions along the wires, causing reflections at various points, with more or less rise of potential. It also causes a very strong tendency to jump between the turns of any coils (especially transformer windings) which may be connected to the circuit.

Protection should be secured first by allowing a considerable margin of insulation, especially for all air distances and surface insulation. Secondly, by the use of lightning arresters near all important apparatus, and for very high-tension work, by the use of static interrupters, or choke coils, in series with the leads of all transformers.

"Static interrupters" act as magnified choke coils, the increase in choking power being obtained by the addition of a condenser between line and ground on the apparatus side of the choke coil. The low equivalent lightning arrester serves to reduce the resistance in series with the discharge path to a minimum by the use of additional spark-gaps shunting a portion of the resistance.

"Static electric waves" in electric cables are similar to those in aerial lines.

[1] Abstract of a paper read before the electrical section of the Franklin Institute, Philadelphia, Pa., May 28.

A New System of Rewarding Machine Shop Labor.

A recent article by Mr. H. L. Gantt has been reprinted in pamphlet form from the machine shop number of *Cassier's Magazine*. This takes up in detail a practical study of the "bonus" system of encouraging operatives to work in harmony with the executive management, for the mutual advantage of each.

The Independent Telephone Association of the United States.

The seventh annual convention of the Independent Telephone Association of the United States will be held in Chicago, Ill., June 24 and 25. The headquarters of the convention will be at the Auditorium Hotel. The general committee in charge of the arrangements anticipates a most enthusiastic and interested gathering, and is completing its facilities for the proper entertainment of the delegates and attendants.

The following gentlemen compose the general committee: J. G. Ihmsen, chairman; H. D. Critchfield, Henry Shafer, C. J. Stiger, Kempster B. Miller, W. A. Kriedler, John R. Dare and H. B. McMeal.

The following programme has been announced:

June 24, 2 P. M.—Address of welcome by the Hon. Carter H. Harrison, Mayor of Chicago; response by the Hon. S. P. Sheerin, of Indianapolis, Ind.; annual address by President James M. Thomas; roll call of states, and reports; paper on "Advantages of Association," by Hon. C. E. Hull, Salem, Ill., president Interstate Independent Telephone Association; "The Telephone and the Technical School," by J. C. Kelsey, professor of telephony, Purdue University, La Fayette, Ind.; "Modern Exchange Construction," by W. H. Johnson, general superintendent Frontier Telephone Company, Buffalo, N. Y.; "Independent Telephone Development in the South," by C. E. Stinson, general superintendent Memphis Telephone Company, Memphis, Tenn.; "Western Telephone Development," by J. S. Bellamy, Knoxville, Iowa. There will be a concert in the Auditorium Hotel at 6 P. M., and at 8 P. M. a special train will start for San Souci Park, the programme of entertainment to be given later.

June 25, 2 P. M.—"Committee Report on Patent Litigation," by the Hon. Hugh Dougherty, Bluffton, Ind.; "Telephone Discipline," by C. E. Tarte, general manager Citizens' Telephone Company, Grand Rapids, Mich.; "Eastern Telephone Development," by F. A. Demarest, general manager Interstate Telephone and Telegraph Company, Trenton, N. J.; "Present and Future," by Frank L. Beam, Columbus, Ohio. This will be followed by general discussion and the election of officers.

It is expected that the regular reduction in railroad fares will be effected by the different passenger associations.

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

Measuring Instruments.

The Leeds & Northrup Company succeeded on June 1 to the business of M. E. Leeds & Company, Philadelphia, Pa. The change is a growth and expansion rather than a transfer of that business. Mr. M. E. Leeds, who has been the managing member of the firm of Leeds & Company, is the president of the new company, and will devote himself particularly to the selling.

Dr. Edwin F. Northrup is the secretary and will have charge particularly of the manufacturing. His training and talents fit him in a very unusual degree for this position in an establishment manufacturing scientific instruments. He took his doctor's degree at the Johns Hopkins University, under Professor Rowland, in 1895, and afterward was for some time professor of physics in the University of Texas. He was then employed in the department of the Westinghouse company which has charge of its original standards and does the calibrating of the working standards. This position he left at the request of Professor Rowland to become engineer of the Rowland Telegraphic Company. In that capacity he was very largely instrumental in developing the Rowland printing telegraph into its present commercial form. These various positions have given him an extensive knowledge of the working requirements of scientific and especially electrical testing instruments, and his ingenuity and training as a designer enable him to produce instruments to meet these requirements.

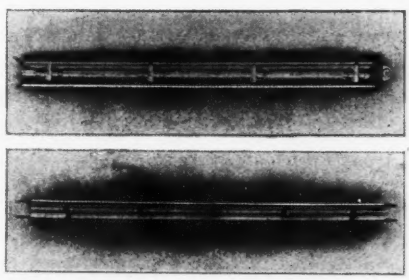
The new company starts under favorable conditions. The business of Leeds & Company has enjoyed a steady growth during its existence, and in the year just passed increased its business thirty-three and one-third per cent over the previous year. During this year, Dr. Northrup has been associated with the company, and there have been developed a number of new and important instruments, and at the same time the regular line has been thoroughly revised where it has been found necessary. The company has availed itself of the opportunities offered by the National Bureau of Standards to keep its reference standards carefully checked, and has made extensive additions to its equipment of tools and secondary standards.

A complete catalogue of the apparatus manufactured by the Leeds & Northrup Company has just been issued, and includes the first descriptions of the new apparatus above referred to. In addition they are publishing the following special pamphlets: No. 1—"Resistance Boxes and Wheatstone Bridges." No. 2—"Potentiometers." No. 3—"Moving Coil Galvanometers." No. 4—"Standard Resistances." No. 5—"Portable Testing Sets and Cable Testing Apparatus." No. 6—"X-Ray Apparatus." No. 7—"High-Grade Keys for Electrical Testing." No. 8—"Self-Induction Apparatus." No. 9—"Carey-Foster Bridge." No. 10—"Hoopes' Conductivity Bridge."

These pamphlets are not confined exclusively to descriptions of the instruments which they cover, but they treat the subject in a broad way, going into the general question of the best designs, and in many cases including detailed instructions for using the instruments.

Linolite.

The accompanying illustrations show two applications of the "Linolite" system introduced by Mr. A. W. Beutel, of London, England. The special feature of



the system is the use of long cylindrical lamps laid in a semi-circular channel of polished metal, the two edges of which are turned over to form a bead in which the feed wires are carried. Unlike the usual type, the "Linolite" glow lamps are made with quite straight filaments passing from end to end, or with filaments having a small expansion loop in the centre. The length of filament is, of course, the same in the "Linolite" as in other lamps, but being straight, and not coiled up, its light, for certain purposes, can be used to better advantage. The lamps and their reflecting channel take up but little room, and are eminently adapted for shop window lighting. Nothing detracts more from the appearance of a shop window than a glaring light in one's eyes from a number of exposed glow lamps, the best effect being obtained when a brilliant light is thrown upon the goods from lamps which are not seen from outside. The "Linolite" channel, with its concealed lamps, can be so installed in a shop window as to be quite concealed from outside view and yet to throw a most effective light upon all the goods displayed therein. The upper illustration shows a length of "Linolite" intended for private house or shop window illumination, the channel being of polished aluminum or nickeled copper, with all the lamp terminals concealed by insulated bridge pieces. The lower illustration shows the clip type for outdoor illuminations in which the terminals are neither protected nor concealed, and for which enameled zinc channel may be used, this method being, of course, cheaper than the indoor pattern. An effective use for the "Linolite" system is for reflected lighting, the lengths of channel being run along the cornice of a room and the light directed on to the white ceiling. The system can be used on any lighting circuit, the lamps being arranged in parallel on low-pressure supplies, and in pairs on high-pressure system, each pair being in series. The lamps can easily be removed for cleaning or renewal, and their life is equal to any other lamp of high-class manufacture.

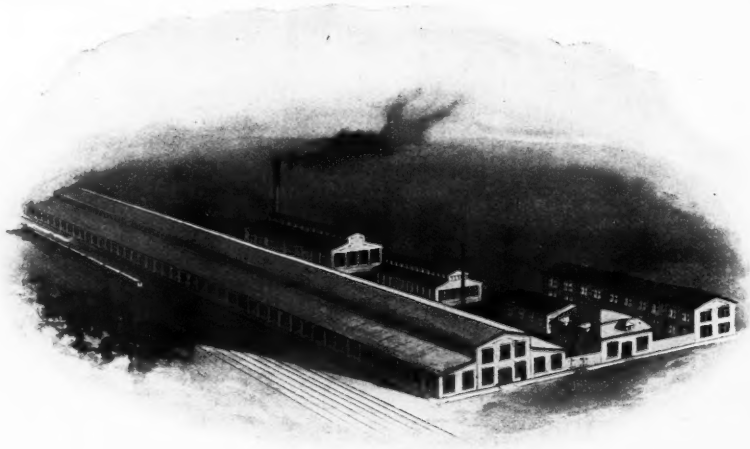
The Cuyahoga Telephone Company.

The report of the president of the Cuyahoga Telephone Company, of Cleveland, Ohio, Mr. Frederick S. Dickson, states that in the near future a surplus will undoubtedly be shown on the books of the company. At the annual meeting, in February, a deficit was reported for the end of 1902 of $29,684.70. On the first of February this deficit had been reduced to $23,382.66; on March 1 to $16,801.49; on April 1 to $9,089.08, and on May 1 to $1,971.66. During 1902 the expenses were 51.6 per cent of the earnings. During April of this year they were 46.07 per cent. During the four months ending April 30, a total of $12,472.55 was expended out of the earnings for the development of the plant, in addition to the ordinary expenditures of $25,270.73 for maintenance. The company is hampered by a debt of $478,505.78, due the Federal Telephone Company, and it is proposed to issue 30,000 shares of six per cent cumulative preferred stock. At the stockholders' meeting on May 21, ninety per cent of the stock was represented, and eighty per cent of the stockholders was present. The secretary of the company, Mr. James B. Hoge, states that the stockholders are pleased with the proposed plan.

Description of the New Pedrick & Ayer Shop.

The recent great industrial activity has caused many manufacturers to build entirely new works, or at least to greatly extend existing plants. The well-known Pedrick & Ayer Company is one of the many concerns forced by the growth of business to seek more commodious quarters. For several years this company occupied its own factory in Philadelphia, extending its rapidly growing line of air tools, while continuing its older line of special railroad tools and appliances in which the company gained its reputation.

A site for the new modern works was purchased immediately adjoining the Clinton avenue station of the Central Railroad of New Jersey at Plainfield, N. J. No expense has been spared in the construction and equipment of the buildings, which are all of brick and steel of slow-burning construction. Good light for all buildings and departments has been especially sought, and convenience to excellent transportation facilities has also been carefully considered.



New Shops of the Pedrick & Ayer Company, at Plainfield, N. J.

The accompanying illustration represents the general arrangement of the plant, which consists of a main shop, 100 feet by 400 feet; boiler house, 40 feet by 40 feet; engine house, 40 feet by 40 feet; immediately adjoining the boiler house, blacksmith shop, 40 feet by 50 feet; pattern and storage shop, 45 feet by 100 feet. There are, in addition, the usual storage bins and small outbuildings.

The main building contains the offices of the company, draughting room, tool room and storage of principal raw materials and finished parts. The principal portion, however, is used for the machine shop proper, the fitting, assembling, testing and shipping departments. The main bay is provided with a fifteen-ton Shaw electric crane equipped with three motors. Besides the main traveling crane, there are numerous hoists and jib cranes actuated by compressed air. The machine tools are all driven by electric motors, the prevailing plan being to group several machine tools on one countershaft, this in turn being belted to a motor of fair size and efficiency. In the testing department proper arrangements are made to provide practical working conditions for the air compressors, portable and stationary riveters, hoists and cranes, which are produced in great variety and size. At the lower end of the main building a spur from the railroad extends three car lengths under the crane, where rapid loading and unloading of machines and products is possible.

The boiler and engine house, with fire wall and metal door between, might be considered as one building. The boiler room is well equipped with all necessary appliances dictated by modern usage and has substantial storage capacity for coal. The engine room contains a belted automatic air compressor of the type largely sold by the company and two direct-connected, dynamo-engine sets for supplying power and light to the entire works. The sets are 150-kilowatt capacity each; the engines furnished by the Ames Iron Works, and dynamos and switchboards by the General Electric Company.

Journal of the British Institution of Electrical Engineers.

The May issue of the *Journal* of the British Institution of Electrical Engineers contains the following papers and discussions: "The Nernst Lamp," by J. Stoettner; "Experiments on Synchronous Converters," by W. N. Thornton; "Railway Block Signaling," by J. Pigg; "Motive Power Supply from Central Stations," by R. A. Chattock, and "Mean Horizontal and Mean Spherical Candle-Power," by Alexander Russell. The number also contains the inaugural addresses of the chairmen of the Newcastle, Birmingham, Manchester and Leeds local sections.

Stow Multispeed Motors in Pittsburg.

A good example of a well equipped, modern manufacturing plant, is the new Twenty-first street factory of the Oil Well Supply Company, of Pittsburg, Pa. Located along the lines of the Allegheny Valley Railroad, the building itself is a model of strength and convenience, and in order to secure the greatest convenience, rapidity and economy in production, nothing seems to have been overlooked by the company's chief engineer, Mr. Henry Hubbard.

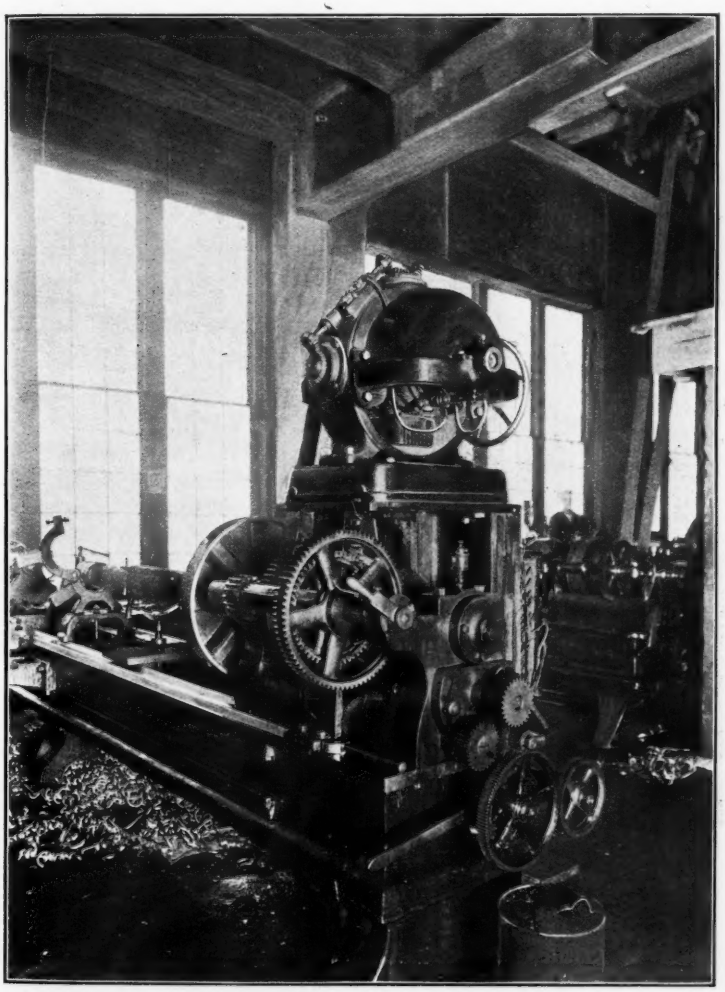
As contributing to the greatest convenience, highest efficiency and maximum shop output, the question of the advisability of electric motor drive hardly required a second thought, but for a time the most engrossing problem was to determine which of the various methods proposed was best suited to the requirements of variable speed drive. The question was finally decided, not upon the basis of hearsay or prejudice, but after a series of careful and rigorous competitive tests of the motors and methods of the various manufacturers. These comparative tests resulted in the selection of the well-known Stow multispeed motor, built by the Stow Manufacturing Company, of Binghamton, N. Y.

In the selection of this motor, the situation required a motor with which all the speeds could be obtained by the use of one voltage only, and one which should be able to develop continuously its full rated horse-power at its lowest as well as its highest speed, and with an efficiency as high at the minimum speed as at the maximum. These conditions were admirably fulfilled throughout a severe test, and orders were placed for thirty Stow motors, varying in sizes from four to ten horse-power, and of the four-pole type, to be used for the driving of individual machine tools.

In the electrical driving of machine tools a serious difficulty is usually encountered, owing to the impossibility of obtaining the full rated horse-power of the motor under low-speed conditions. This difficulty is clearly explained when it is considered that in those methods by which the speed is reduced by lowering the voltage, an increase of current proportional to the reduction in voltage is

absolutely necessary if constant horse-power output is to be secured.

For example, if it is required to operate a 220-volt motor at one-half normal speed by applying a voltage of 110 at the brushes, the current required to develop the full horse-power of motor would be double the normal, the C^2 R or heating effect in the armature coils would be four times the normal value, and the resulting rise of temperature of the armature would be such as to make it impracticable to run the motor under such conditions, except for very brief periods. As one voltage only is used at the terminals of the Stow motor, the difficulties cited are entirely obviated and the motor will develop its full rated horse-power at any conceivable speed within its range.



MULTISPEED MOTOR DRIVING TWENTY-SIX-INCH BRIDGEFORD LATHE.

The accompanying illustration shows one of the four-horse-power Stow motors driving a twenty-six-inch Bridgeford lathe.

The severity of the tests on this four-horse-power motor may be inferred from the fact that steel chips, averaging about one-half an inch wide and one-sixteenth of an inch thick, were turned off at the rate of seventy-five feet per minute, causing the point of the tool to melt, and throwing a 100 per cent overload on the motor. The above test, in which the steel chips were removed at the rate of twenty-eight cubic inches per minute, was repeated several times, and while it required from thirty seconds to one minute to put the cutting tool out of order, the motor received no damage whatever.

In this installation there is a noticeable absence of all auxiliary apparatus and wiring, as the motors are entirely self-contained and operate on one voltage only. As no resistance or rheostat of any kind is used to regulate the speed, the electric circuits of the motor remain absolutely unchanged.

Reversible motor starters of the Cutler-Hammer type are used to bring the motors up to speed, and when mounted on lathes the speed-regulating hand wheel is located on the side of the motor in a position most convenient for the operator.

From the A. Garrison Foundry Company, also of Pittsburg, Pa., orders have been recently received for sixteen Stow multispeed motors of four, six, eight and ten-horse-power capacity to be applied chiefly to the driving of its roll lathes.

The manufacturer of this motor is now getting out a new illustrated catalogue, showing this motor applied to various machine tools, power pumps, and other apparatus requiring variable speed drive, and would be pleased to mail a copy to all enquirers.

Gas-Power Plant in Cement Works.

The Iola Portland Cement Company has recently ordered from Westinghouse, Church, Kerr & Company a 280-horse-power, three-cylinder, vertical gas engine as an addition to the extensive power equipment of its cement plant at Iola, Kan. The company operates its plant upon natural fuel and is one of the largest users of gas power in the cement manufacturing field. The present equipment comprises twelve engines of the Westinghouse vertical three-cylinder and two-cylinder, single-acting type, aggregating 2,100 horse-power. These engines operate various classes of machinery, such as rock crushers, rotary kilns, line shafting and generators, for supplying light and incidental power throughout the works. With the additional engine the power plant will comprise six engines of 280 horse-power each, five of 125 horse-power each, and two small engines. The 125-horse-power engines are used for driving the kilns and the 280-horse-power for the rotary crushers. The machinery is in general arranged in groups upon sections of counter-shafting driven by a single engine, either direct-connected or rope driven.

In point of size the installation has few precedents, and its successful operation under severe conditions demonstrates the many advantages of gas power for industrial establishments of all kinds.

Solder for Aluminum.

A solder for aluminum, which forms the subject of a recent patent, consists of aluminum five parts, antimony five parts and zinc ninety parts. To make it harder, use a little more antimony and a little less zinc. The solder is prepared as follows: The aluminum is first melted in a pot. The zinc is then added, and when this is melted the antimony is added. The metal is then thoroughly puddled with sal-ammoniac. When the surface of the metal is quite clear and white it should be poured into sticks ready for use, the cinder being first removed.

Electric Specialties Exhibit.

The Crouse-Hinds Electric Company, Syracuse, N. Y., had an elaborate exhibit of its electric specialties at the Auditorium Hotel, Chicago, Ill., during the convention of the National Electric Light Association last week. The accompanying illustration shows one view of the apartment wherein the Crouse-Hinds exhibit was placed.

This company is the manufacturer of knife switches, radial switches, switchboards, panel boards, distributing boards, headlights, and special electrical and mechanical appliances. The company is also the manufacturer of the celebrated "Syracuse" changeable headlight for trolley cars. The light is thrown by a twelve-inch polished aluminum reflector, parabolic in shape, protected by a steel jacket which resists all the jars of hard usage.

CROUSE-HINDS ELECTRIC COMPANY'S EXHIBIT AT CONVENTION OF NATIONAL ELECTRIC LIGHT ASSOCIATION, CHICAGO.

The "Norbitt" enclosed contact specialties are made by the Crouse-Hinds company, in addition to the apparatus already mentioned. These porcelain specialties meet the latest requirements of the Board of Fire Underwriters, regarding the elimination of all exposed contacts.

The installation of these appliances avoids all soldering, tapering and compounding. The parts are made to carry one hundred per cent heavier current than that for which they will be used, and the screw shells are made of the best Lake copper. Among the "Norbitt" specialties may be enumerated the temporary socket for decorative lighting, the permanent receptacle for show-window decoration, the permanent moulding receptacle, the permanent receptacle for conduit and sign work, the fuseless cord rosette for moulding work, the fuseless fixture rosette, and the "Norbitt" weatherproof socket.

The exhibit included a complete line of these specialties, and a large number of visitors enjoyed the opportunity of inspecting in a compact space this liberal line of material.

St. Louis Manufacturers' Association.

The report of the St. Louis Manufacturers' Association, issued by L. D. Kingsland, the president, gives an outline of the work of a general character that has come before the association during the past year. The executive council has had prepared a bill which will be brought before the St. Louis City Assembly, asking for a reduction of fifty per cent in the rates now charged for water used through meters. As soon as new belt lines and improvements now being made in the terminal facilities of the several railroads are completed, freight receiving and shipping stations will be established in the west end and the extreme northern and southern territory. The association has assisted in having an appropriation made for the laying of pneumatic tubes connecting the post office with different sections of the city, thereby saving much time in the gathering and delivery of mail.

Other features which have been the objective of the association's endeavors are improvement of St. Louis and the public streets and highways; a freight terminal for eastern shipments; a new Wabash freight terminal; the alleviation of unnecessary and oppressive laws; national eight-hour-labor-day law and state eight-hour-labor-day law; the establishment of the United States Department of Commerce; settlement of labor troubles by arbitration; additional post office facilities for St. Louis; gas and electric meter inspection; state factory inspection law, and factory inspection by the city.

Oil Transformers.

There can be no doubt of the important part played in electrical development by the static transformer. Electric power transmission and electrical distribution for lighting would be commercially impracticable were it not for this simple, efficient and reliable apparatus. Various conditions call for differing modes of construction, but the oil transformer—that is, the transformer in which the containing case is filled with oil—can show a record for satisfactory service which is probably not surpassed by that of any other machine.

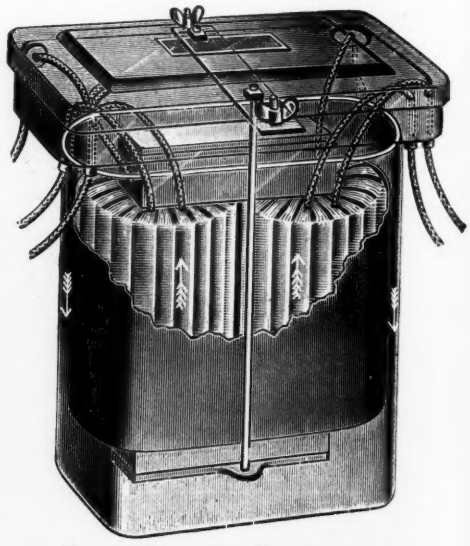


FIG. 1.—DETAILS OF TRANSFORMER.

The accompanying illustrations give a good idea of the appearance and constructive details of the Kuhlman oil transformer. This transformer is of the core type, the advantages claimed for this type being a better chance for cooling of the windings, and therefore better

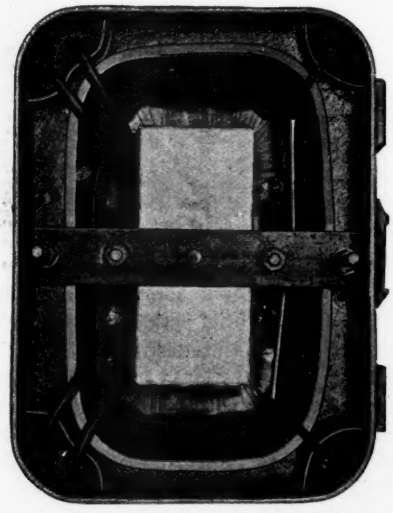


FIG. 2.—ARRANGEMENT OF COILS AND LEADS.

regulation, less leakage, and accessibility of all vital parts. By the use of oil, heat developed in the core and windings is taken up and conducted rapidly to the case. For this purpose, circulation is necessary, and to ensure this these transformers have a sheet of fibre wound around the transformer proper, which separates the rising and descending currents of oil. Oil also increases the breakdown resistance of the insulation, and tends to make this self-healing when there is a breakdown, due to a static discharge or lightning. Air is kept from reaching the windings by the oil, and this prevents slow charring of insulation on the wire.

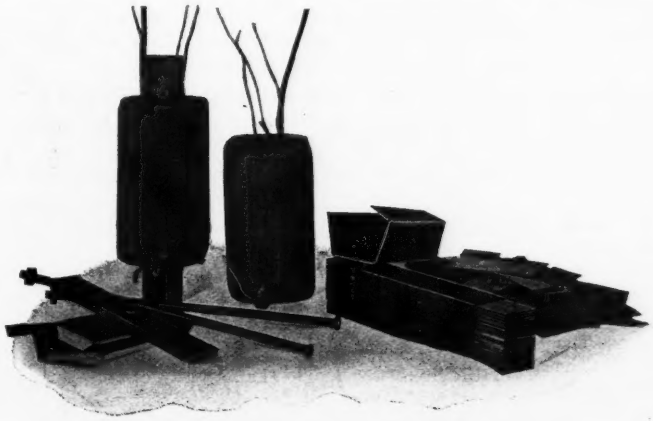


FIG. 3.—INTERIOR ASSEMBLY OF TRANSFORMER.

The case of this transformer is made of galvanized sheet steel, instead of being a heavy casting of iron, the advantages claimed for this construction being that it is much lighter and more easily handled. It also allows the case to be made larger, giving ample room for plenty of oil. These cases are all carefully soldered and painted with weatherproof paint, so that there is no leakage of oil.

The base and top of the case are of cast iron, the weight of the transformer being carried by the heavy cast-iron supporting ring at the top, so that no strain is thrown upon the case when the transformer is hung. Two types of hanger can be furnished with this transformer. For smaller sizes the Elkhart hanger or hook is recommended. This is fastened to the pole by means of lag screws, and the transformer is then swung into position easily by one man. The other type is the usual cross-arm hanger.

Fig. 1 gives a general view of the transformer with the case partially broken away. This shows the long overhanging lip of the cover, and the fibre sheet which separates the currents of oil. It also indicates the method of bringing out the leads, this being shown more in detail in Fig. 2.

The transformer coils are wound on special forms, the secondary winding being placed first. Flexible insulation is placed on the form, and the winding started. As it proceeds, sheet insulation is placed between the successive layers, this extending out beyond the ends of the winding, thus leaving no possibility for a short-circuit developing from layer to layer. The primary winding is wound over the secondary, so as to keep the high voltage as far as possible from the core. These coils are all interchangeable.

These transformers are made in all sizes from one-half a kilowatt to fifty kilowatts, and may be connected for 1,000 or 2,000 volts, but this connection is made at the factory avoiding any possibility of a mistake due to an error of the wiremen.

The four secondary leads from the two secondary coils are brought out at the front of the case, and enable the transformer to be connected in series or in multiple, or for three-wire distribution.

There has been some trouble, due to capillary attraction of the insulating material on the terminals. To avoid this, the insulation has been stripped off down to the level of the oil, and a fibre tube has been placed over the bared portion. To prevent the possibility of moisture entering the case where the leads issue, an oil-proof cement is poured over the bushings around the leads, making an air-tight joint. The cement also holds the leads rigidly in their proper position.

Fig. 3 shows the parts of this transformer before assembling, and gives a good idea of the substantial construction.

The Pass & Seymour porcelain primary fuse box is supplied with these transformers, making the replacing of the burned-out fuse easy and safe.

These transformers are manufactured by the Kuhlman Electric Company, Elkhart, Ind.

The New York Electrical Society.

At the regular meeting of the New York Electrical Society, May 20, the following committee was nominated for the season of 1903-1904: For president, J. J. Carty; for vice-presidents, W. I. Donshea, Hobart D. Betts, W. S. Barstow, Douglass Burnett, F. C. Bates and H. C. Townsend; for secretary, George H. Guy; for treasurer, Henry A. Sinclair.

Philadelphia Section of the American Institute of Electrical Engineers.

The last meeting for the season of the Philadelphia branch of the American Institute of Electrical Engineers will be held on Monday evening, June 8, at eight o'clock, at Drexel Institute, Thirty-second and Chestnut streets. Mr. Joseph Menchen, of New York city, designer of electrical theatrical effects, will show how electricity is made use of on the stage, and will illustrate with actual apparatus and scenery how such effects as waterfalls, sand storms, moving clouds, water ripples, rainbows, etc., are produced upon the stage.

It is also expected that Mr. W. L. Hodges will show experimentally the speaking arc. Ladies are invited to this meeting. There will be an informal dinner at "Boothby's" restaurant, Chestnut street, below Thirteenth, to which all of the members are invited.

BOOK REVIEWS.

"Simple Scientific Experiments." Aurel De Ratti. London. Dawbarn & Ward, Limited. Paper. 69 pages. 5 by 7¼ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at 25 cents.

This book gives a series of about fifty experiments, all of which may be performed with ordinary apparatus. The amateur experimenter will find much to interest him, and the experiments can all be easily understood from the illustrations which accompany each experiment.

"Machinery for Model Steamers." Percival Marshall. London. Dawbarn & Ward, Limited. Paper. 70 pages. 5 by 7¼ inches. Numerous illustrations. Supplied by the ELECTRICAL REVIEW at 25 cents.

This book is one of the regular issues of the "Model Engineer" series, and its aim is to be a practical handbook on the design and construction of engines and boilers for model steamers. The engine designs are novel, and are calculated to give the best possible results in the class of work for which they are designed. The boilers are of simple construction, and the author states will be found suited to cope with the adverse conditions under which the model launch boiler usually works. A chapter on firing by means of liquid fuel describes the various methods of employing this apparatus, and a short chapter is included on the proportioning of engines and boilers to the size of boat.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

SOUTH AFRICAN POWER STATION—It is stated that an electric lighting and power system is to be installed at Port Elizabeth, South Africa, the estimated cost being about $5,000,000. A water supply system is also projected, to cost nearly $1,500,000. Tenders are being invited for rails and accessories to be used in the construction of an electric traction system in Johannesburg. The road before completion, it is stated, will cost some $7,000,000.

CHICAGO TRACTION PLANS—It is announced that the receivers of the Union Traction system, Chicago, Ill., will be authorized to make large expenditures in the near future for the improvement of the system. Cable trains on the north and west are to be displaced by underground trolley cars before January 1. Primarily, the plan is to convince the public that the Union Traction interests are ready to better and facilitate the service. The proposed work will cost between $1,000,000 and $2,000,000. The added facilities that will thus be given are expected to win popular approval, and will increase the receipts of the company.

LARGE OHIO MERGER—A large merger of public utility companies has been reported in process of formation at Columbus, Ohio. It is the general impression in financial circles at this point that in a short time practically all the gas, electric light and street railway concerns of the state will be included in one corporation, with a capitalization of from $400,000,000 to $500,000,000. The larger interurban lines, it is stated, will be tributary connections of this merger, with the Dolan-Elkins interests back of the merger. The merger had its beginning recently, when the consolidation of the local street railway, Edison Electric Company and the Columbus Gas interests was effected.

THIRD-RAIL ECONOMIES—The report of the Manhattan Railway Company to the State Railroad Commission, for the quarter and the nine months ended on March 31, has been published. The total number of passengers carried in the first three months of this year was 65,193,975, which compares with 58,037,249 in the corresponding period of 1902, and 50,448,918 in the same period of 1901. For the nine months the total number of passengers carried was 180,481,586, an increase of 22,921,489, compared with the nine months ended March 31, 1902. The gross earnings for the quarter showed an increase of $351,828, with an increase in operating expenses of only $63,750. This is construed as an indication of the economical working of the third-rail system. For the nine months the gross earnings show an increase of $1,127,888, with an increase in operating expenses of only $41,225.

COLUMBUS (OHIO) PUBLIC UTILITIES SYNDICATE—The Columbus Railway and Light Company has been organized in Columbus, Ohio, the plan of which is to control the entire street railway and electric lighting interests of the city. The most prominent corporations to be merged are the Columbus Railway Company, the Columbus Edison Company and the Columbus Gas and Light Company. The incorporators are: P. W. Huntington, Emil Keisewetter, Edwin Sharp, F. W. Prentiss and Randolph S. Warner. The charter states that the purposes of the organization of the new company are the acquiring by purchase or lease, constructing, extending, owning, maintaining and operating, by means of electricity, street railways or interurban railways, or both, in the city of Columbus, and lines of such railroads extending from the said city within, through and between the municipalities located from the said city within, through and between the municipalities located in the county of Franklin and territory continguous to this county; also the purpose of maintaining and operating plants for the manufacturing and selling of light, heat, power and fuel, by the means of electricity, natural or artificial gas; also for the purpose of acquiring by lease or purchase all the property, franchises, rights and privileges of any company or companies organized for the purpose of supplying electricity or natural or artificial gas for power, light, heat or fuel purposes.

ELECTRIC RAILWAYS.

EVANSVILLE, IND.—The county commissioners have granted a franchise to the Evansville, Boonville & Rockport Traction Company. The road will be fifty miles long.

JOLIET, ILL.—It is stated that the Rockford & Freeport Electric Railway Company is planning to build a line from Winnebago to Byron, as a feeder to its Freeport line.

CLEVELAND, OHIO—The Tuscarawas Traction Company has been sold to the Tucker-Anthony Company, of Boston, Mass. The road runs from Canal Dover through New Philadelphia to Ulrichsville, Ohio.

CAIRO, ILL.—The stockholders of the Cairo Electric Railway Company have voted to change the company's name to the Cairo Electric and Traction Company, and to increase the capital stock to $150,000.

HUNTINGTON, L. I.—The highway commissioners of this town have granted a fifty-year franchise to Wilkins K. Putnam, of Brooklyn, for the construction of a trolley road across this town to connect Huntington and Amityville.

ROCKFORD, ILL.—The Quincy & Western Illinois Railway Company has purchased the franchise of the Quincy & Southern Electric Railway Company, and will build two lines—one north to Niota, fifty-five miles, and one east to Beardstown, seventy miles. It is expected that the eastern line will be in operation by August of this year. The company has a capital of $3,000,000.

LOUISVILLE, KY.—The Pascagoula Railway and Power Company has been organized with a capital of $400,000. The company will build an interurban line in Mississippi, and control the utilities of four towns—Pascagoula, Scranton, East Side and Moss Point. Charles A. Ballard is president; L. A. Anderson, Moss Point, Miss., vice-president, and G. Spratt Bridges, secretary.

YOUNGSTOWN, OHIO—The Youngstown & Salem Railroad Company and the Youngstown & Southern Railway Company have been incorporated by Ashabel W. Jones, R. L. Andrews, John H. Ruhlmand, Jonah R. Long, W. S. Anderson and Jaspar W. Long. The former has $300,000, and the latter $1,500,000 capital stock. The latter is to run from Youngstown, Ohio, to East Liverpool, and the former makes a connection near Leotonia, and runs to Salem.

SCRANTON, PA.—The Dalton Street Railway Company, with a capital of $500,000, has been organized to build a road to extend from Providence through the Notch to Clark's Summit, Glenburn, Dalton and to Factoryville, also passing through La Plume. The company has already organized with the following officers: Abraham Nesbitt, of Kingston, president; Thomas R. Wright, of the Wilkesbarre Traction Company; Dr. James Ashley, of Ashley, and James M. Boland, of Wilkesbarre.

INDIANAPOLIS, IND.—The Logansport, Hammond & Chicago Traction Company has filed articles of incorporation with a capital stock of $1,000,000. The directors are George F. McCulloch, Horace O. Stilwell, A. L. Drum, Harry E. Guthrie and Arthur W. Brady. This line will be an extension of the one now being built from Indianapolis to Logansport, and when completed will connect this city with Chicago. Franchises for the line to Chicago have already been granted by Logansport, Winamac, North Judson, Hobart, Grass Creek, Knox, Valparaiso and Hammond.

SOUTH BETHLEHEM, PA.—A charter has been granted to the Stroudsburg & Wind Gap Electric Street Railway, to build a road that will connect the Stroudsburgs with the system of street railways that traverses Northampton County. The exact route of the road has not been published, but it will touch Kunkletown, Kellersville, Sciota, Saylorsburg and Ross Common. The capital is $100,000, and the entire length of the road will be sixteen and one-half miles. The incorporators are: John S. Osterstock, Easton; Herman F. Ziegler, Nazareth; John MacAdams, Pen Argyl; John G. Honecker, Easton; John J. Heintzleman, Nazareth, and others.

TELEPHONE AND TELEGRAPH.

WINFIELD, MD.—The Carroll County Telephone Company is extending its line to Winfield.

BUCK CREEK, IND.—The J. E. Eckhart Telephone Company has been incorporated with a capital of $10,000.

BOLTONVILLE, VT.—The new telephone line from Corinth to Wells River and Woodsville, N. H., is reported under way.

PEORIA, ILL.—A farmers' telephone company has been organized in Spring Lake township to operate a local telephone line.

CAMBRIDGE, NEB.—The Holbrook & Frontier Telephone Company, recently organized, will build a line from Holbrook to Eustis.

MADISON, WIS.—The Jefferson County Telephone Company has filed an amendment increasing its capital stock from $8,000 to $15,000.

PERU, KAN.—The Doshbaugh Telephone Company has purchased the Sedan Home Company's equipment, and is arranging to improve the service.

CADILLAC, MICH.—The Michigan Telephone Company will have a telephone exchange in operation by next month. The cost will amount to about $20,000.

DES MOINES, IOWA—The Jones County Telephone Company has filed amended articles of incorporation, increasing its capital stock from $50,000 to $100,000.

LUDINGTON, MICH.—Business men of Ludington and Scottville have organized a rural telephone company to provide Mason County with first-class service.

BRIMFIELD, IND.—The McCarty Bell Telephone Company has been incorporated by W. A. McCarty, C. W. Bluss and John T. Graves, with a capital of $10,000.

AUSTIN, TEX.—The Grayson County Telephone Company, of Sherman, has filed an amendment to its charter increasing its capital from $170,000 to $340,000.

NEWPORT, TENN.—The American Telephone and Telegraph Company is to build a long-distance telephone line from Morristown, Tenn., through Asheville to Spartanburg.

LINCOLN, NEB.—The Home Telephone Company, of Grand Island, with a capital of $20,000, has been incorporated by George B. Bell, Fred W. Ashton, Charles B. Ryan and Hiram J. Palmer.

CAMERON, W. VA.—At a meeting of the stockholders of the Cameron Telephone Company, the following directors were elected: D. R. Meighen, B. J. Ferrell, J. H. Wise, B. F. Meighen and Fred Wise.

LAWRENCEBURG, IND.—The People's Telephone Association of Indiana, has purchased the line of the Dearborn County Telephone Company, organized about three years ago with a capital of $5,000.

ROCHESTER, N. Y.—The Seneca-Gorham Telephone Company has been incorporated to do business in the city of Geneva, the villages in the counties of Ontario and Yates, and intermediate points. The capital stock is $6,000.

WILLIAMSPORT, PA.—The Loyalsock Telephone Company has made application for a charter. The company will have a capital stock of $25,000, and the work of constructing a line between Montoursville and Loyalsockville will be started at once.

WOLCOTT, N. Y.—Work is soon to begin on three telephone lines to run from Wolcott. The first will extend to Huron, where connections will be made with North Rose. The second will run south to West Butler, and the third to North Wolcott.

BATAVIA, N. Y.—Papers of incorporation of the Darien Telephone Company have been filed in the county clerk's office. The company will operate a telephone system, with the principal exchange at Darien, with lines extending to Corfu, North Darien and Ray.

ONEONTA, N. Y.—The independent telephone companies of Delaware and Otsego counties have formed an organization called the Otsego-Delaware Independent Telephone Association. The president is S. F. Adee, Delhi, and W. W. Capron, of Oneonta, is secretary.

SANDUSKY, OHIO—A new telephone company has been organized at Bliss, with a capital of $500, for local service, and also to construct and operate farmers' lines in connection with the Bell system. Franklin H. Wilson is president; E. E. Buck, vice-president, and D. S. Merville, secretary.

FAIRFAX, S. DAK.—At a meeting of the stockholders of the company recently formed here for the purpose of constructing a telephone line between this place and Echo and Scalp Creek, the following were elected directors: Z. K. Doane, C. F. Pierce, E. Scheinest, E. L. Dufur and Peter Hansen.

IRONTON, OHIO—The Ohio Valley Telephone Company has been organized with a capital of $200,000, to consolidate the independent companies between Charleston, W. Va., and Cincinnati. It will enter Cincinnati with a line from Portsmouth, and will extend to Lexington, Ky., Lebanon, Ohio, and Wilmington, Ohio.

ST. PAUL, MINN.—The Farmers' Mutual Telephone Company, of Emmons, has filed articles of incorporation with a capital of $10,000. The company will operate a telephone system in Freeborn County. The directors are: H. N. Bergerson, P. A. Peterson, George C. Emery, R. N. Troe, L. A. Troe, L. A. Larson, O. A. Thompson, S. Davidson.

SIDNEY, N. Y.—The Riverside Telephone Company's line has been constructed between the villages of Bainbridge and Sidney. The line connects with eight different lines at Bainbridge, and with four at Trestle, Chenango County, besides the long and short-distance systems at Sidney. The organization of the company is as follows: President, Alonzo Lilly, of Bainbridge; vice-president, George A. Bentley, of Sidney; secretary and treasurer, Chris Tobey, of Bainbridge.

ELECTRICAL SECURITIES.

Notwithstanding that among professional speculators the statement is often heard that further declines are in order, and that with the indications of a slackening of industrial activity in many directions, securities will reach a lower point in price than has yet been established, there is a very evident sentiment that securities have touched the bottom price, and that a rally is now in order. While the market is undoubtedly held in restraint by the monetary and labor outlook, the indifference of a number of large interests, or rather the lack of any apprehension of serious difficulty, is held to be indicative of the absolute stability of conditions in general.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 6.

New York:	*Closing.*
Brooklyn Rapid Transit	59¾
Consolidated Gas	198
General Electric	181
Kings County Electric	200
Manhattan Elevated	136⅞
Metropolitan Street Railway	128¾
New York & New Jersey Telephone	161¼
Westinghouse Manufacturing Company	191
Boston:	*Closing.*
American Telephone and Telegraph	152
Edison Electric Illuminating	270
Massachusetts Electric	82
New England Telephone	135
Western Telephone & Telegraph preferred	95

The Massachusetts Electric Companies have declared the regular semi-annual dividend of $2 per share on the preferred stock, payable July 1 to stock of record June 16.

Philadelphia:	*Closing.*
Electric Company of America	8½
Electric Storage Battery common	69
Electric Storage Battery preferred	70
Union Traction	45⅞
United Gas Improvement	90¾
Chicago:	*Closing.*
Chicago Telephone	140
Chicago Edison Light	150
Metropolitan Elevated preferred	67½
National Carbon common	23¾
National Carbon preferred	94
Union Traction common	3½
Union Traction preferred	32

ELECTRIC LIGHTING.

RUSHFORD, MINN.—St. Charles has voted in favor of a municipal electric lighting plant, to cost $10,000.

ROCKLAND, MASS.—The Church Green Electric Light Company has been absorbed by the Edison company. The consideration was $200,000.

CARTHAGE, N. Y.—The Wetmore Electric Light Company has contracted with the trustees of Lowville to light the streets of that town for five years.

UTICA, N. Y.—The trustees of the village of Lowville have entered into a contract with the Wetmore Electric Company to light the streets of the village for a period of five years from May 5, 1903.

MILWAUKEE, WIS.—The Northwestern Fuel Company will construct an electric power plant which it is expected will develop 50,000 horse-power by means of the surplus heat from the coke ovens.

KENNETT SQUARE, PA.—The United Gas Improvement Company, of Philadelphia, has sold its Kennett electric light plant to the White Creek Clay Supply Company. The price is stated to have been $30,000.

SALT LAKE CITY, UTAH—The directors of the Utah Light and Power Company have decided to install an auxiliary plant in connection with its Jordan station. The cost will be $150,000, and 2,000 additional horse-power will be developed.

MENOMONIE, WIS.—The Wisconsin Power Company has been formed by J. H. Coulter, L. E. Gary and other Chicago capitalists. The company has purchased water power rights on the Red Cedar River, and will begin operations as soon as possible.

MOBILE, ALA.—The consolidation of the Mobile Gas Light and Coke Company and the Electric Lighting Company, of Mobile, has been effected. The business of both companies will be carried on under the name of Electric Lighting Company, of Mobile.

STERLING, ILL.—A dam is to be constructed at once across Rock River, twelve miles west of this city, to cost $200,000, and which will develop about 15,000 horse-power. The power will be used for propelling many of the electric railways that are now in course of construction in various parts of the state and for other purposes.

SPRINGFIELD, MASS.—The state board of gas and electric light commissioners has acted favorably on the application of the Great Barrington Electric Light Company for the approval of an issue of new capital stock of the par value of $26,200, and of bonds to the amount of $10,000, to pay the cost of additions to the plant and to refund existing bonds.

CALUMET, MICH.—The Calumet Light, Heat and Power Company has filed articles of incorporation. The purpose of the company is to conduct a central heating plant for the distribution and sale of heat, and in connection therewith an electric plant for light and power. The company is capitalized at $80,000. Among those interested are John Burder, P. B. Roehm and A. W. Kerr.

BALLARD, WASH.—The Ballard Electric Company, a corporation organized for the purpose of taking over the municipal lighting plant of Ballard, under a fifty-year lease, with the option of purchase by the city at the end of twelve years at an appraised valuation, has taken possession of the property. The officers of the new company are: Walter G. Clark, president; J. J. McCafferty, vice-president; W. R. Bell, secretary; C. A. Kilbourne, treasurer.

NEW INCORPORATIONS.

ELIOT, ME.—Eliot Telephone Company. $5,000.

TROY, N. Y.—White Creek Telephone Company. $3,000.

DALLAS, TEX.—The Telephone Company, of Leger. $5,000.

LIVINGSTON, TEX.—Livingston Telephone Company. $3,000.

DES MOINES, IOWA—Big Grove Township Telephone Company. $2,000.

SUMTER, S. C.—The Sumter Telephone Company. Increased to $10,000.

AUGUSTA, ME.—Tri-State Telegraph and Telephone Company. $6,000,000.

JERSEY CITY, N. J.—The Southern Kansas Electric Railroad Company. $325,000.

LOGANSPORT, IND.—Northwestern Indiana Independent Telephone Company. $10,000.

ST. PAUL, MINN.—The Stevens County Telephone Company. Increased from $10,000 to $15,000.

PIERRE, S. D.—Dell Rapids, S. D., Farmers and Merchants' Rural Telephone Company. $100,000.

NEBAGAMON, WIS.—Nebagamon Telephone Company. $5,000. Incorporators: Fred G. Johnson, Bernhard Skare and R. C. Oglivie.

ALBANY, N. Y.—Chazy Telephone Company. $3,000. Incorporators: Alexander W. Fairbank, Seth Gordon and William H. Robinson.

LEGAL NOTE.

DECISION IN THE WARNER TUBULAR DROP SUIT—A decision has been rendered by Judge Wing, in the United States Circuit Court, Northern District of Ohio, in the suit of the Western Electric Company, of Chicago, Ill., *versus* the North Electric Company, of Cleveland. Ohio, on patent No. 477,616, issued June 21, 1892. This patent covers the Warner tubular drop. The suit has been decided in favor of the North Electric Company. It is stated that none of the complainant's contentions was sustained, and among other causes for an adverse opinion was the claim of lack of patent ability.

PERSONAL MENTION.

MR. CHARLES DAY, of the firm of Dodge & Day, of Philadelphia, read a paper on "Machine Shop Methods" before the S. K. C. Club at Pittsfield, on May 27.

MR. PERCY H. THOMAS, of Pittsburg, Pa., read a paper on "Static Discharges in Electric Circuits" before the electrical section of the Franklin Institute, at Philadelphia, Pa., on May 28.

MR. ARTHUR JONES, of Chicago, has joined the selling organization of the National Electric Company, of Milwaukee. He will be connected with the Chicago office of this company and devote his time to the sales in Cook County.

MR. WILLIAM J. HAMMER gave a lecture on "Radium and Radioactive Substances" at the thirty-fourth annual meeting of the New Jersey State Microscopical Society, held in the Ballantine Gymnasium, Rutgers' College, New Brunswick, Monday evening, May 25.

MR. THOMAS A. EDISON has accepted the appointment of honorary chief consulting electrician of the Louisiana Purchase Exposition. The following letter has been received by President Francis:

ORANGE, N. J., May 18, 1903.

David R. Francis, President St. Louis Exposition.

Dear Sir—I beg to acknowledge receipt of your favor of April 22, informing me of the great honor done me in appointing me honorary chief consulting electrician of the Universal Exposition, commemorating the acquisition of the Louisiana Territory.

In thanking you for this honor, and accepting it, I can not but note with pleasure your reference to the fact that the exposition year falls on the twenty-fifth anniversary of my perfection and introduction of the incandescent lamp. This recognition of work in the field of electrical invention is very gratifying to me, especially as it comes in association with your magnificent demonstration to the world of what has been done in all branches of industry in the states comprised within the original territory—a region where, as a young telegrapher, I spent many arduous years before moving East.

Permit me to commend your judgment in allotting at the exposition a fine large building exclusively for electricity, and to express the fervent hope that it will be filled to overflowing with the latest examples of apparatus for light, heat and power and the communication of intelligence.

It will not only be my duty to take part in exhibiting such of my newer inventions as your colleagues may deem worthy of acceptance, but I hope to see from abroad, in rivalry with American advances, the results due to European leaders in the art to which I have given my life, because of my belief in it as one of the noblest agencies ever rendered available for human welfare and benefit.

With the best wishes for the brilliant success of the exposition and pledging my own assistance as it may be required, I have the honor to remain, Mr. President,

Yours very truly,

THOMAS A. EDISON.

Mr. Edison has recently been appointed to the board of technical directors, it is announced, of the Marconi Wireless Telegraph Company of America. It is stated that certain of Mr. Edison's patents will be controlled by the company, and that he will be permanently identified with this interest.

INDUSTRIAL ITEMS.

THE RAND DRILL COMPANY, 128 Broadway, New York city, has just issued a new circular describing a number of pneumatic tools and appliances. This will be mailed on request.

THE STANDARD ELECTRICAL MANUFACTURING COMPANY, Niles, Ohio, is calling attention to the "Star" incandescent lamp. This company will be pleased to submit for inspection accurate information upon request.

THE PNEUMATIC ENGINEERING COMPANY, 128 Broadway, New York, recently installed a plant in the South with the air lift system of pumps, having a capacity of 9,000,000 gallons of water per day, from four ten-inch wells.

THE WHITE STAR APPLIANCE COMPANY, 316 Potomac avenue, Buffalo, N. Y., advises that it has established a Canadian branch at Port Colborne, Ontario. This company manufactures mast-arms, known as the "White Star Duplex," and the "Vita Stirrup," for arc lamp service.

HARVEY HUBBELL, Bridgeport, Ct., manufacturer of electrical specialties, brass and iron machine screws and machinery, announces the opening of a branch office at 93 Nassau street, New York city. This office has been placed under the management of Mr. C. W. Beach, who is the eastern representative for the Hubbell specialties.

THE COLUMBIA INCANDESCENT LAMP COMPANY, 2115 Locust street, St. Louis, Mo., is calling attention to its product with a unique folder entitled "In a Dark Corner." The Columbia company has considerable literature on the subject of incandescent lighting and will be pleased to send this, on application, to any one interested.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, is distributing bulletins Nos. 1008 and 1021, descriptive of engine-type generators for direct currents, and type "B" direct-current motors. Both of these bulletins are printed in a most excellent fashion, and present some very interesting and striking views.

THE ELECTRIC APPLIANCE COMPANY, Chicago, Ill., selling agent for the Gutmann alternating-current wattmeter, is receiving a large number of orders for its glass-case meter. This meter possesses a number of features which make it very popular, and the company will be pleased to send its new wattmeter catalogue to any one interested.

THE OTIS ELEVATOR COMPANY, New York city, is busy with a number of contracts for elevator installations, both in the United States and abroad. A notable example of this is an order secured from the Duke of Marlborough for two electric elevators, with push-button control, to be installed in his new London residence, Blandford House, Curzon street.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, 136 Liberty street, New York city, is sending a weekly stock report to fan dealers, showing the stock on hand in the New York warehouse. The company invites buyers to send for samples and make their own tests. These reports are of value as showing the large stock which is available for immediate supply.

THE CENTRAL ELECTRIC COMPANY, Chicago, Ill., is handling a large business in direct and alternating-current desk, bracket, ceiling and battery fan motors and ventilating fans of every description. Catalogues describing this apparatus will be sent on request. Other strong specialties of the Central Electric Company are "Okonite" wires, cables, taping and insulation.

THE LAGONDA MANUFACTURING COMPANY, 15 and 17 West Washington street, Springfield, Ohio, manufacturer of the Weinland turbine tube cleaners for water-tube boilers, has recently issued a new catalogue describing and illustrating this apparatus. In addition to the descriptive matter the catalogue contains a number of testimonials commendatory of the use of this apparatus.

THE GERMANIA ELECTRIC LAMP COMPANY, Essex street, Harrison, N. J., in presenting its new price list, calls attention to its new factory and high-grade apparatus for producing its standard incandescent lamps. Every process of manufacture is followed with the utmost care, and each lamp is carefully tested after each operation by careful and competent inspectors. The company will be pleased to send illustrated literature on request.

THE DeVEAU TELEPHONE MANUFACTURING COMPANY, 27 Rose street, New York city, has just closed a contract for the complete telephone system at the Willard Hotel, Washington, D. C., and also a contract for a complete telephone plant for Luna Park, Coney Island. This company has also secured a large order for telephones to be used by the New York Central Railroad Company, and is about to ship a complete telephone plant to Alaska.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., and Chicago, Ill., has printed a fine bulletin describing bridging telephones, and illustrating how to organize, build and maintain a rural telephone line. This bulletin is a valuable addition to telephone literature, and for parties requiring information on this subject, the arrangement is excellent and answers apparently every question which might be raised.

THE NEW YORK CENTRAL & HUDSON RIVER RAILROAD COMPANY'S publishing department has issued in pamphlet No. 8 of the "Four-Track" series a number of trips of interest, describing two to fifteen days' pleasure tours from the mouth of the Hudson River to the chasms of Niagara. This pamphlet will be of great value in assisting those who are undecided in the proper selection of a vacation recreation, and will be sent by Mr. George H. Daniels, general passenger agent, on request.

THE EASTERN CARBON WORKS, Jersey City, N. J., is the manufacturer of several types of high-grade primary batteries of the carbon porous cup type, and also of the standard dry battery type. The carbon cup and cover are made in one piece, giving a good connection from the binding-post to the body of the battery, and low internal resistance. These batteries possess other features of merit, detailed information regarding which the company will be pleased to mail on application.

THE DE LA VERGNE REFRIGERATING MACHINE COMPANY, East 138th street, New York city, is issuing a catalogue descriptive of the Hornsby-Akroyd patent safety oil engine. This engine contains a number of features of special importance, ignition apparatus in the shape of tubes, batteries or spark coils being obviated. The ignition is caused by the heated walls of the vaporizing chamber and by the heat of compression, the method being entirely automatic. This catalogue will be sent to any one interested upon request.

THE EDWARDS RAILROAD ELECTRIC LIGHT COMPANY, Cincinnati, Ohio, is equipping a number of locomotives with its electric headlight. These electric headlight equipments are made in four classes, and throw both a horizontal and vertical beam of light. The current for the light is generated by a steam turbine placed over the boiler arch of the locomotive, the current being supplied to a focussing arc light. The company has recently published a catalogue descriptive of these equipments, which will be sent to any one interested upon request.

THE BENDIT MERCANTILE ENGINEERING COMPANY, engineer and contractor, successor to the Laufketter-Bendit M. E. Company, announces the election of Mr. E. O. Edson as secretary and treasurer. Mr. F. C. Laufketter retires to become president of the Victor Manufacturing Company, of St. Louis, Mo. The company will conduct the business along the same general lines as in the past six years, and will continue to act as representative for a number of prominent engineering concerns. Mr. Louis Bendit is president of the company.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., is distributing some important literature of great value to the electrical fraternity. Recent bulletins, Nos. 1042, 1043 and 1044, describe, respectively, arc circuit cutouts, single-phase generators, type "W. A. L.," and belt-driven generators for lighting and power. A handsome pamphlet, which the company has just issued, describes the installation and operation of direct-current series arc lighting

apparatus, "Wood" system. This booklet is replete with good information, and goes very carefully into the subject indicated by the title.

THE NORTON EMERY WHEEL COMPANY, Worcester, Mass., is presenting a reprint in book form of an article in the *American Machinist*, on "Grinding and Its Possibilities When Used in Conjunction with Proper Grinding Machines and Grinding Wheels." This subject is of interest to the metal-working manufacturer, and recent rapid changes in methods of producing cylindrical work quickly and accurately make this article of practical value. Mr. Charles H. Norton is the author of the article, and the exclusive study which he has given to this branch of business ensures a practical and noteworthy effort.

THE STANDARD STEAM SPECIALTY COMPANY, New York city, manufacturer of the "Utility" exhaust muffler, oil separator, return tank, pump governor and feed-water heater, and other steam specialties, has recently taken contracts for 20,000 horse-power of its apparatus. To facilitate manufacturing, and to be in a position to carry in stock standard sizes of "Utility" oil separators of 30 to 10,000 horse-power, the company has leased the premises at 542 and 544 West Broadway, from May 1. This will give them 10,000 square feet of floor space, and the trade is invited to call and inspect the new quarters.

THE STANLEY ELECTRIC MANUFACTURING COMPANY, Pittsfield, Mass., has sold thirty-two 38-horse-power and twenty 50-horse-power street railway motors to the Sheboygan Light, Power and Railway Company, of Sheboygan, Wis. A sale has also recently been made of a 750-kilowatt, engine-type, railway generator to the Trenton Street Railway Company. Columbus & Southern Railway Company the following apparatus: Forty-eight type No. 402 railway motors; one 500-kilowatt revolving field generator; one 300-kilowatt rotary converter; three 110-kilowatt and three 150-kilowatt transformers, and the necessary switchboard apparatus.

THE CONSOLIDATED RAILWAY, ELECTRIC LIGHTING AND EQUIPMENT COMPANY, 100 Broadway, New York city, is making rapid strides in the adaptation of its system to the lighting and ventilating of leading railway lines. The company makes the suggestion that the United States postal cars and railway mail service will be a favorable field for the application of this system. The use of incandescent lamps would greatly facilitate the work of the mail clerks, in placing the lights where they would be most convenient; and the axle light system of furnishing power would allow of ventilating fans being used, which would keep the temperature of the mail car to a proper level.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., manufacturer of chloride accumulators, has recently installed and has in process of installation a number of large batteries for railway work. Among these may be mentioned two batteries for the United Traction Company, of Albany, each having a capacity of 700 kilowatts. These will be located at Albany and Troy respectively, and will be operated in connection with special boosters for regulating fluctuations. The Cleveland, Painsville & Eastern Railway Company is to install about June 1 a battery having a capacity of 460 kilowatts. This battery is operated in connection with a motor-driven differential booster, and the installation is designed to relieve the station of fluctuations, to care for peaks, and allow the station to be operated with fewer generators than are now in service.

THE B. F. STURTEVANT COMPANY, Boston, Mass., has designed and installed a "hot blast" system of heating and ventilation for the Hope Mills Manufacturing Company, of Hope Mills, N. C. All steam coils are concentrated in a heater in the basement, through which the air is drawn by a fan and distributed to the several rooms through galvanized iron piping and brick flues. The fan is driven by a direct-connected horizontal engine, which exhausts into a section of the heater. The remainder of the heater is of such capacity that using exhaust steam from the mill engines, the buildings can be heated to a temperature of seventy degrees Fehrenheit when the temperature is ten degrees above zero outdoors.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., is making extensions to its Newark, N. J., works. The large increase in sales of integrating wattmeters and other electrical recording instruments has made this extension necessary. The company manufactures its own meter tools, jewels and special appliances. The factory is equipped with the most modern machinery, and the mechanical features are of the highest order of merit. The company has recently sold to the Toledo, Bowling Green & Southern Traction Company a 250-kilowatt rotary converter, which will be used for supplying current to its lines. Power will be received in the form of alternating current from the Maumee Valley Electric Company, which is installing a 250-kilowatt inverted Westinghouse rotary converter for the purpose, together with three 150-kilowatt transformers.

THE COLUMBUS STEEL ROLLING SHUTTER COMPANY, Columbus, Ohio, has recently issued a catalogue describing steel rolling doors, shutters and apparatus, and samples of slatting. The special features of this company's construction are weather-proof surface, possessing no pockets or recesses for the accumulation of water, snow or dirt, preventing rusting out and premature decay; a perfectly balanced spring within the roller, which makes it possible to raise or lower the largest door without effort, and a construction of slatting which affords the minimum of friction and the maximum of strength. A small bead within the large barrel of the pivotal hinge very materially stiffens the door against wind pressure or any other strain to which it may be subjected, and makes unlocking of the slats an impossibility. The company is enjoying a very large demand for its material, and is contemplating erecting a modern manufacturing plant during the coming season, where increased facilities and proximity to railroads will combine to enable it to supply any demand. Some of the largest factories in the country are equipped with these rolling shutters, doors and apparatus.

THE ALLIS-CHALMERS COMPANY, New York Life Building, Chicago, Ill., announces the following partial list of engine sales for April, 1903: National Tube Company, McKeesport, Pa., three 46 and 48, 84 and 84 x 60, vertical, steeple, cross-compound furnace blowing engines; Carnegie Steel Company, Pittsburg, Pa., two pairs 44 and 84, 84 and 84 x 60, vertical, standard, disconnected compound blowing engines; National Steel Company, Pittsburg, Pa., two 50 and 96, 96 and 96 x 60, vertical, steeple, cross-compound furnace blowing engines; Morowebb Cotton Mill Company, Dallas, N. C., one 20 x 42, 1890 frame, horizontal, Reynolds-Corliss engine; Smeeth's Copper and Bronze Company, Chicago, Ill., one 14 and 28 x 24, vertical, cross-compound, condensing, direct-coupled engine, one 12 and 24 x 12, and 20 x 36, air compressor; Wheeling Steel and Iron Company, Wheeling, W. Va., one 44 and 84 x 60, vertical, standard blowing engine; Construction Company of America, New York city, two 20 and 40 x 42, 1890 frame, horizontal, cross-compound Reynolds-Corliss engines; Grand Rapids Veneer Works, Grand Rapids, Mich., one 32 x 48, 1890 frame, horizontal, Reynolds-Corliss engine; Munising Paper Company, Limited, Munising, Mich., two 20 x 36, 1890 frame, horizontal, Reynolds-Corliss engines; American Steel and Wire Company, Shoenberger Works, Pittsburg, Pa., one 46 and 84 x 60, vertical, standard, long crosshead, Bessemer blowing engine, one 80 and 84 x 60, vertical, standard, low-pressure furnace blowing engine; C. A. McDonald, Chicago, one 16 x 36, girder frame engine; Thomas A. Anderson & Company, Lancaster, Ohio, one 10 x 36, 1890 frame, Reynolds-Corliss engine; James M. Arnold, Chicago, one 16 x 36, 1890 frame, Reynolds-Corliss engine; El Oro Mining and Railway Company, Mexico, one 20 and 40 x 42, 1890 tandem-compound Reynolds-Corliss engine; Harbison-Walker Company, Pittsburg, Pa., one 22 x 48, girder frame Reynolds-Corliss engine; Kingsford Foundry and Machine Works, Oswego, N. Y., one 20 and 14 x 42, 1890 half-duplex air compressor; Valley Oil Mills, Memphis, Tenn., one 18 x 36, girder frame, Reynolds-Corliss engine; Wheeling Steel and Iron Company, Wheeling, W. Va., one 44 and 84 x 60, vertical, standard, blowing engine; Cunningham, Becheheimer Supply Company, Norborne, Mo., one 12 x 36, girder frame, Reynolds-Corliss engine; Larson & Greenough, Mullan, Ida., one 10 x 30, girder frame, Reynolds-Corliss engine. The company has just issued a book giving a list of the users of Reynolds-Corliss engines. This includes 190 closely printed pages, and is a good directory of power installations. The general offices of the company are now on the fourteenth floor of the New York Life Building, corner La Salle and Monroe streets, Chicago, Ill.